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MARINE FISHES NEW OR UNCOMMON TO LONG ISLAND, NEW YORK[1]

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ABSTRACT

The distribution and occurrence of the inshore marine fishes of Long Island have not been well documented since the records of the State biological survey in 1938 were published. The present paper contributes information about new, rare and unusual fishes that appeared in 1962 and 1963 in the south-shore bays and adjacent ocean. The species new to New York include: *Epinephelus morio* (Valenciennes); *Mycteroperca microlepis* (Goode and Bean); *Mycteroperca phenax* Jordan and Swain; *Lutjanus analis* (Cuvier); *Lutjanus jocu* (Bloch and Schneider); *Bothus* sp. (an undescribed form).

There have been few publications in recent times concerning marine fishes new to or rarely encountered in the New York area. Bean (1901, 1903) and Nichols and Breder (1926) compiled synopses of the fishes of New York which were complete at the time. But since then, only Breder (1938) and Greeley (1939) have made substantial contributions to complement the previous works. Additional faunal lists were compiled by Breder (1931, 1932), Breder and Redmond (1929), Breder and Nigrelli (1934), Gordon (1949), Nichols (1949) and others. Since Gordon (1951) published on the common marine fishes of New York, however, no similar study has been made.

In 1962 an unusual number of fishes new and rare to New York were encountered during the course of regular field activities. Data on these, and others collected in 1963, are given together with notes on observations by others. Several specimens are illustrated.

[1] Most of the specimens were collected during field operations for Federal Aid in Fish and Wildlife Restoration Project F-15-R. The authors wish to thank the members of this and other Federal Aid fish research projects who aided in collecting and preserving these specimens. Credit is due Nick Drahos of the New York Conservation Department for photographing the specimens illustrated. We extend our gratitude to Dr. C. Lavett Smith of the American Museum of Natural History for identifying a series of juvenile groupers. Thanks are also due to him and to Dr. Victor G. Springer of the U.S. National Museum for examining and submitting their opinions on the identification of a small number of juvenile snappers.

Rhinoptera bonasus (Mitchill) Cownose ray

One specimen, 870 millimeters in total length and 515 millimeters in width, was taken by haul seine in the ocean surf east of Smith Point Park on Fire Island on October 16, 1963. The water temperature was 59° F. and the salinity was 31.0 0/00 at the time of capture. Although this species was considered uncommon in the New York area (Nichols and Breder, 1926), Breder and Nigrelli (1934) reported common occurrences in Sandy Hook Bay in New Jersey between June 28 and October 5 in 1934. The present specimen, however, is the only record we can find from the south shore of Long Island and apparently establishes a new late date of capture for New York.

Albula vulpes (Linnaeus) Bonefish

A total of 108 specimens were collected at Mercer's Island in Great South Bay on six occasions between August 14 and September 24 in 1962. Sizes (in fork length) ranged from 33-54 millimeters in August to 60-81 millimeters in September. Additional physical and biological data were presented by Alperin and Schaefer (1964). This is the first recorded occurrence of small juvenile bonefish in New York. Specimens have been deposited in the collections of Cornell University (No. 44015, 44019, and 44020) and the University of North Carolina Institute of Fisheries Research (No. 3860 and 3861). Nichols and Breder (1926) considered the species "accidental, October". Specific records were reported by Bean (1903) for Great South Bay, by Breder and Nigrelli (1934) for Long Island Sound (a 2-foot specimen, October 1933) and by Latham (1964) at Orient (one of 21 inches on October 1, 1939 and another of 14 inches on July 17, 1940).

Synodus foetens (Linnaeus) Inshore lizardfish

A total of 35 specimens were captured at various locations in Great South, Moriches and Shinnecock Bays between July 12 and October 10 in 1962. They ranged from 45 to 220 millimeters in fork length. Water temperatures and salinities ranged from 58° to 80° F. and from 19.4 to 27.2 0/00, respectively, on the collecting dates. Bean (1901) reported the species as very common in Great South Bay in 1890, and Nichols and Breder (1926) reported it as generally occurring from September to October 30 in the New York area. Furthermore, Breder (1931) reported collecting "many" between September 3 and 30 in 1930 in Sandy Hook Bay. Bean (1901), however, captured only one specimen in Great South Bay in 1898, and Greeley (1939) reported seining only one small individual (taken August 8, 1938 at Mattituck Inlet on Long Island Sound). In addition, Latham (1964) presented a few records of 9-inch specimens from the Orient area taken on September 3, 1935; May 30, 1943; October 12, 1949 and May 30, 1953. The present authors did not record this species in 1963.

Hyporhamphus unifasciatus (Ranzani) Halfbeak

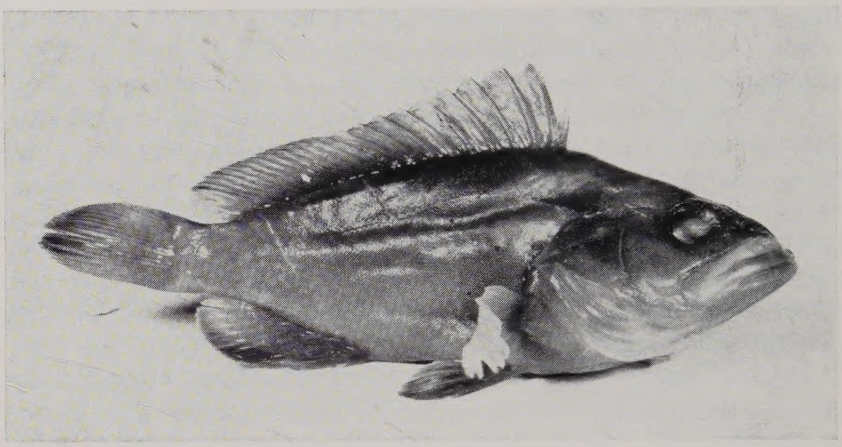
This species was recorded as "rare" by Bean (1903) and as "uncommon, August to October 16" by Nichols and Breder (1926) in the New York area. In later publications, Breder (1932) and Breder and Nigrelli (1934) reported the capture of two specimens in 1932 and another individual in 1934 from Sandy Hook Bay in New Jersey. Greeley (1939) reported three specimens from Jones and Fire Island Inlets which he considered a "stray occurrence of young", and Gordon (1949) recorded the taking of two small individuals during a summer survey at Coney Island. Three individuals were collected during 1962; one, 90 millimeters in fork length, was taken on September 10 at Hart Cove in Moriches Bay, while the other two, 95 millimeters and 80 millimeters in fork length, were captured at Mercer's Island in Great South Bay on September 17 and 18, respectively. At the time of capture, water temperatures ranged from 67° to 69° F., and salinities from 23.2 to 25.4 0/00.

Fistularia tabacaria (Linnaeus) Cornetfish

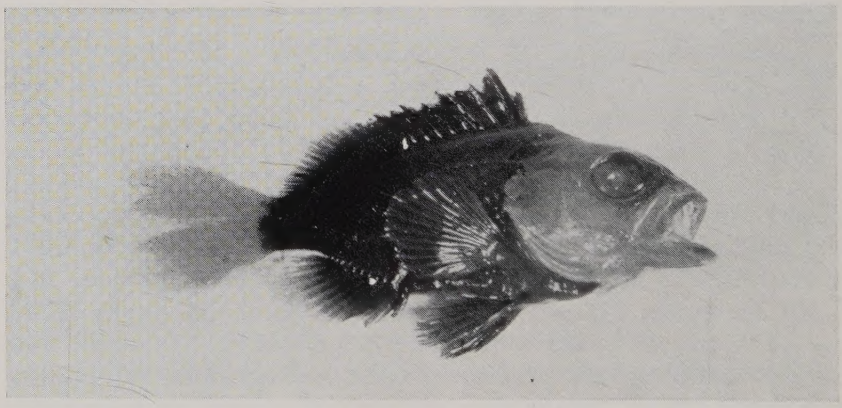
Nineteen specimens, 150 to 320 millimeters in total length, were taken from several different locations in Shinnecock, Moriches, and Great South Bays and in the Fire Island surf during 1962. On 10 collecting dates between August 27 and October 19, temperatures at the time and place of capture ranged from 58° to 73° F. and salinities ranged from 23.2 to 32.1 0/00. An additional seven specimens, 195 to 290 millimeters in total length, were taken in 1963; four were captured at Hart Cove in Moriches Bay (water temperature 67° F., salinity 28.6 0/00) on August 27 and three in Wells Creek at Shinnecock Bay—one on August 27 (water temperature 72° F., salinity 27.0 0/00) and two on October 1 (water temperature 62° F., salinity 30.0 0/00). Nichols and Breder (1926) reported the species as "uncommon, September and October, to October 16" in the vicinity of New York, although Greeley (1939) reported seven individuals (160 to 215 millimeters in total length) taken in Fire Island Inlet in 1938. Bean (1903) reported taking four examples from the Great South Bay area and Latham (1964) has recorded two occurrences since 1930; one a 7-inch specimen taken at Orient on November 1, 1950 and the other a 38-inch specimen captured at Montauk in 1936.

Epinephelus morio (Valenciennes) Red grouper

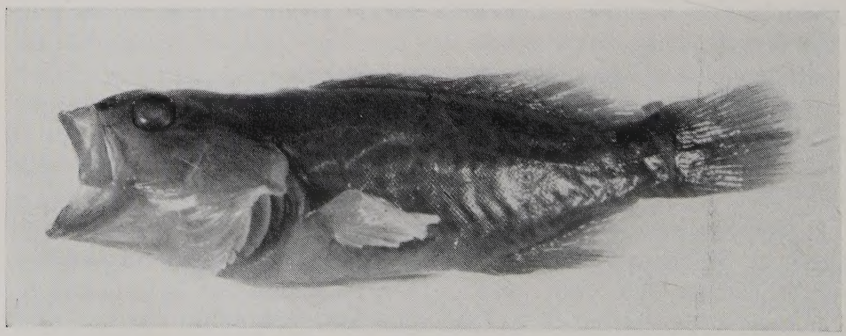
One specimen, 63 millimeters in total length, was taken at Smith Creek at Shinnecock Bay on September 13, 1962 (water temperature 68° F., salinity 28.0 0/00), and another, 90 millimeters in total length, was captured in the State Boat Channel near Captree State Park in Great South Bay on October 19, 1962 (water temperature 61° F., salinity



Epinephelus morio red grouper (total length 90 millimeters)



Epinephelus nigritus Warsaw grouper (total length 30 millimeters)



Mycteroperca microlepis gag (total length 75 millimeters)

27.0 0/00). Greeley (1939) reported the capture of two young specimens, 35 and 51 millimeters long, from Fire Island Inlet, but Smith[2] found these specimens actually to have been *E. niveatus* and *E. nigritus*, respectively, and included them in his synopsis of the groupers (Smith, 1961). Apparently the specimens taken in 1962 are first records for New York.

Epinephelus nigritus (Holbrook) Warsaw grouper

One specimen, 30 millimeters in total length, was captured in Middle Pond in Shinnecock Bay on October 10, 1962 (water temperature 58° F., salinity 29.0 0/00). This is the second known record from New York. Greeley (1939) reported the first record, although the specimen was misidentified as *E. morio*[2].

Epinephelus niveatus (Valenciennes) Snowy grouper

A total of 12 specimens, averaging 3½ inches in length, were reported taken by seining in Fire Island Inlet at Captree State Park on October 15 and October 23 in 1962 (Loret, 1962). The fish were identified by Dr. D. deSylva of the University of Miami Marine Laboratory. Although this species has been reported as not rare in the Woods Hole region in Massachusetts (Nichols and Breder, 1926), the only previous records for Long Island were presented in Breder and Nigrelli (1934), Greeley (1939) and Nichols (1949), although Greeley's specimen was misidentified as *E. morio*[2].

Mycteroperca microlepis (Goode and Bean) Gag

One individual, 75 millimeters in total length, was taken in Hart Cove in Moriches Bay (water temperature 80° F., salinity 19.4 0/00) on August 6, 1962. Another, 122 millimeters in total length, was taken in Smith Creek at Shinnecock Bay (water temperature 68° F., salinity 28.0 0/00) on September 13, 1962. These specimens appear to be the first records of the gag in New York waters.

Mycteroperca phenax Jordan and Swain Scamp

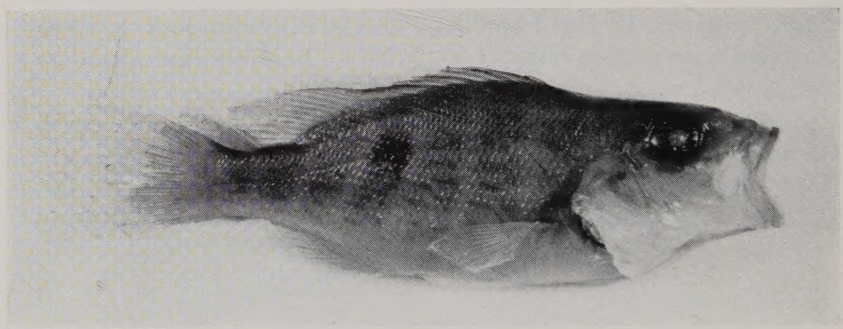
One specimen, 68 millimeters in total length, was collected from Smith Creek at Shinnecock Bay on August 9, 1962. The water temperature was 69° F. and the salinity was 28.8 0/00 at the time of capture. This is the first record of the scamp in New York.

Lutjanus analis (Cuvier) Mutton snapper

A total of 24 specimens, 38 to 75 millimeters in fork length, were taken at various locations in Shinnecock, Moriches, and Great South Bays between August 6 and October 10 in 1962. Water temperatures ranged from 58° to 81° F. and salinities from 19.4 to 28.6 0/00 at the time and

[2] C. L. Smith, personal communication.

Mycteroperca phenax scamp (total length 68 millimeters)



Lutjanus analis mutton snapper (fork length 75 millimeters)

place of capture. These are the first published records of the species occurring in New York.

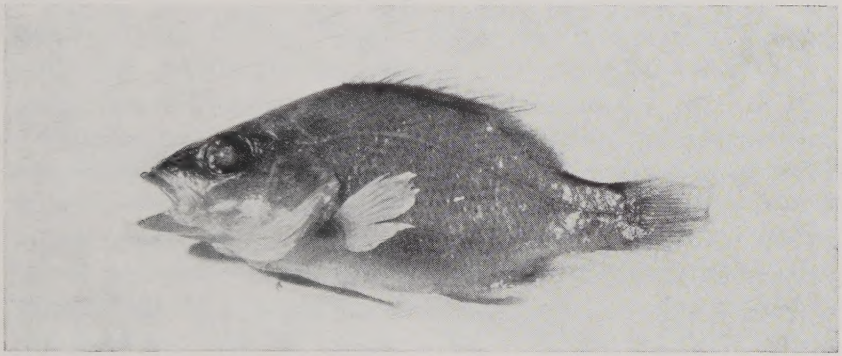
Lutjanus griseus (Linnaeus) Gray snapper

Ten specimens, 18 to 72 millimeters in fork length, were seined at various locations in Shinnecock, Moriches and Great South Bays between July 17 and October 8 in 1962. Water temperatures ranged from 60° to 81° F. and salinities varied from 19.4 to 28.8 0/00 at the time of capture. An additional 10 specimens were captured in 1963; eight, 32 to 50 millimeters in fork length, were seined at Old Fort Pond in Shinnecock Bay on August 28 (water temperature 69° F., salinity 26.8 0/00) and two, 20 and 52 millimeters in fork length, were taken, respectively, at Hart Cove in Moriches Bay on July 31 (water temperature 74° F., salinity 25.0 0/00) and at Middle Pond in Shinnecock Bay on October 3 (water temperature 62° F., salinity 28.2 0/00). Breder and Nigrelli (1934) reported the capture of one 60-millimeter specimen in Sandy

Hook Bay in New Jersey and Greeley (1939) recorded several individuals, all less than 1 inch long, in seine collections from Long Island waters. Gordon (1949) collected only one small specimen (0.6 inch) during an entire summer's seining at Coney Island. These appear to be the only previous records of the species having occurred in the New York area.

Lutjanus jocu (Bloch and Schneider) Dog snapper

Two specimens, 31 millimeters and 64 millimeters in fork length, were captured, respectively, at Timber Point on Great South Bay on July 17, 1962 (water temperature 70° F., salinity 23.0 0/00) and at Hart Cove in Moriches Bay on September 10, 1962 (water temperature 71° F., salinity 23.2 0/00). These are the first records of the species for New York.



Lutjanus jocu dog snapper (fork length 64 millimeters)

Furthermore, the only other record from the northwestern Atlantic appears to be that of a young fish taken at Woods Hole in Massachusetts on September 21, 1897 (Nichols and Breder, 1926).

Pristigenys alta (Gill) Short bigeye

Two specimens were collected in 1962. One, 29 millimeters in total length, was taken in the surf at Democrat Point on Fire Island on July 18 and the other, 50 millimeters in total length, was captured in Old Fort Pond in Shinnecock Bay on October 10 (water temperature 58° F., salinity 28.8 0/00). This species was considered "very rare, August 20 to November 3" by Nichols and Breder (1926). Breder and Nigrelli (1934) reported the capture of several 1-inch specimens from Long Island Sound and Greeley (1939) reported three young specimens (36 to 41 millimeters long) that were seined at Fire Island Inlet between July 27 and August 11. Latham (1964) reported one specimen from Orient on October 12, 1944 and two others, 1½ inches and 5 inches long, from Gardiner's Bay on September 27, 1941 and September 11, 1943, respectively. Caldwell (1962), in his development and distribution

study of the species, included two small specimens (23-24 millimeters long) collected at Quogue in August 1952. Apparently the July 18 specimen is an early season record for New York.

Alectis crinitus (Mitchill) African pompano

Three specimens, 65 millimeters, 75 millimeters and 100 millimeters in fork length, were taken by haul seine in the ocean surf west of Smith Point Park on Fire Island on August 21 and 22, 1963. The water temperature was 68° F. and the salinity was 31.2 0/00 on both days. An earlier, unreported specimen, taken by hook and line at the entrance to Sheepshead Bay on September 10, 1956, was 139 millimeters in fork length with dorsal filaments extending 574 millimeters and anal filaments 551 millimeters. The species was considered to be rare in the vicinity of New York (Nichols and Breder, 1926). Previous records reported by Breder and Nigrelli (1934) include several specimens collected on July 25 and September 20 and 27 in 1934 in Sandy Hook Bay in New Jersey. Latham (1964) reported one specimen from Long Island Sound (Orient) taken on June 15, 1939, and Ginsburg (1952) included one record from Great South Bay but gave no date of capture. The latter specimen may be that reported by Bean (1903) as having been taken in a pound net at Islip on August 18, 1898.

Decapterus macarellus (Cuvier) Mackerel scad

A single specimen, 50 millimeters in fork length, was seined from the surf at Old Inlet on Fire Island on August 30, 1962. The water temperature was 71° F. and salinity 29.6 0/00. Greeley (1939) reported a 77-millimeter specimen taken in Fire Island Inlet on August 8, 1938. Nichols and Breder (1926) reported this scad to be "sometimes abundant in fall at Woods Hole, Massachusetts", but they did not report it from New York and it was not included by Breder (1938) in his list of species recorded from New York Harbor. However, Bean (1903) reported it was seined in abundance in the Atlantic Ocean at Southampton on August 31, 1897, and the present authors observed it on one occasion in large numbers in Fire Island Inlet during the summer of 1959.

Trachinotus falcatus (Linnaeus) Permit

Fifteen specimens, 36 to 49 millimeters in fork length, were seined in Hart Cove in Moriches Bay on October 8, 1962 (water temperature 60° F., salinity 28.2 0/00) and an additional four specimens, 27 to 35 millimeters in fork length, were taken at the same location in 1963; one on July 31 (water temperature 76° F., salinity 24.6 0/00) and three on October 1 (water temperature 61° F., salinity 28.8 0/00). Three other individuals, 30 to 32 millimeters in fork length, were taken from Old Fort Pond in Shinnecock Bay on August 28, 1963 (water temperature 69° F., salinity 26.8 0/00).

Trachurus lathami (Nichols) Rough scad

One specimen, 65 millimeters in fork length, was taken by haul seine in the ocean surf west of Smith Point Park on Fire Island on June 27, 1963 (water temperature 62° F., salinity 31.0 0/00), and two additional specimens, 89 millimeters and 95 millimeters in fork length, were captured in Wells Creek at Shinnecock Bay on July 31, 1963 (water temperature 76° F., salinity 28.0 0/00). Bean (1901) reported a single Long Island specimen taken October 16, 1898 at Clam Pond Cove in Great South Bay, while Nichols and Breder (1926) reported the rough scad as "very rare in late summer and fall, August 28 to November" in the Long Island area. On the other hand, Latham[3] took one or more specimens every year or so at Orient and once had as many as five in one season. A recent specimen, from low salinity water in Great South Bay, was reported by Isaacson (1964). The June 27 specimen is probably an early season record for New York.

Mullus auratus (Jordan and Gilbert) Red goatfish

One specimen, 99 millimeters in fork length, was captured in Smith Creek at Shinnecock Bay on September 13, 1962 (water temperature 68° F., salinity 28.0 0/00) and four other individuals, 110 to 130 millimeters in fork length, were taken at the same location on October 8, 1962 (water temperature 63° F., salinity 29.8 0/00). An additional specimen, 45 millimeters in fork length, was seined in the State Boat Channel at Oak Beach on Great South Bay on July 5, 1963 (water temperature 71° F., salinity 29.6 0/00). The species was listed as "occasionally common, September and October" by Nichols and Breder (1926). Although Breder and Redmond (1929) reported its occurrence in Sandy Hook Bay in New Jersey for the first time in 1928 and Breder (1931) found it there "in numbers" in 1930, Bean (1903) had recorded three specimens from Sandy Hook Bay on October 8, 1897 and reported that large numbers were seen there by fishermen in September and October of that year. The first Long Island record was a specimen collected October 17, 1898 near Clam Pond Cove in Great South Bay (Bean, 1901). Also, Greeley (1939) reported five specimens, 53 to 89 millimeters long, collected between July 27 and August 22 in 1938 at Fire Island Inlet. Latham (1964) reported one record for Orient, a 5½-inch specimen taken on November 11, 1941.

Chaetodon ocellatus (Bloch) Spotfin butterflyfish

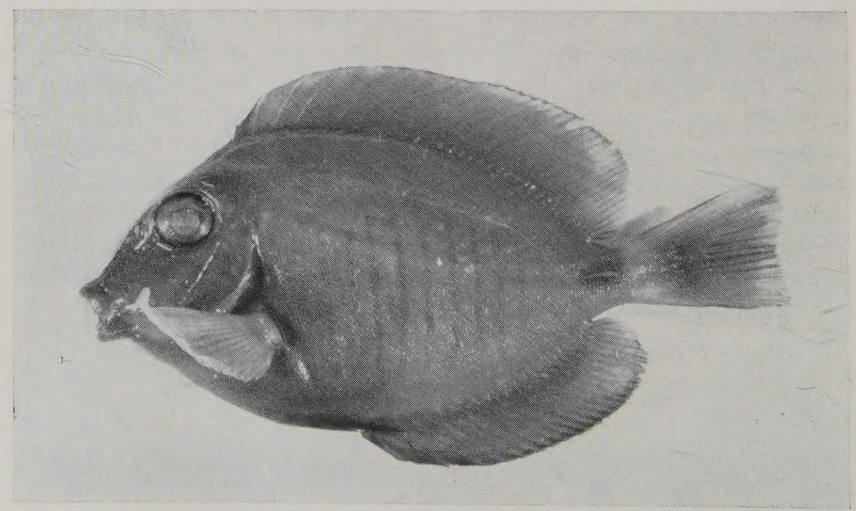
This butterflyfish appeared in considerable numbers during 1962 and 1963. Thirteen specimens were collected between August 6 and October 10 in 1962 in Moriches and Shinnecock Bays, and others were reported from Great South Bay. The size range for measured specimens was 23

[3] R. Latham, personal communication.

to 36 millimeters in total length. At the time of collection water temperatures ranged from a high of 80° F. (August 6 and 8) to a low of 58° F. (October 10) and salinities varied from 19.4 to 28.6 0/00. In the same areas 29 specimens were collected during the period from July 30 to October 3 in 1963. These fish ranged from 15 to 55 millimeters in total length with both the smallest and largest having been taken in the first days of October. The temperature range at collecting sites was 79° to 61° F. and salinities varied from 25.0 to 29.6 0/00. This ordinarily uncommon species was reported by Greeley (1939) only from Fire Island Inlet where 18 specimens were taken during August. Nichols and Breder (1926) found it to be infrequent in the New York-Long Island region, but widespread in distribution. Latham (1964) reported the species from Orient as early as July 17 in 1943 and Breder (1932) as late as October 26 in 1932 at Sandy Hook Bay in New Jersey. None of these authors reported specimens as large as those collected in 1963 when five specimens taken from Old Fort Pond in Shinnecock Bay on October 3 measured 35 to 55 millimeters in fork length. Also, Bean (1903) obtained a 2-inch specimen from a fish pound near Clam Pond in Great South Bay on October 17, 1898.

Acanthurus chirurgus (Bloch) Doctorfish

Two examples were collected on successive days in mid-September of 1962 at Shinnecock Bay. The first, taken at Old Fort Pond on September 12, measured 64 millimeters in fork length and the second, taken at Smith Creek, was 71 millimeters in fork length. Surface water temperature was 69° F. on September 12 and 68° F. on September 13,



Acanthurus chirurgus doctorfish (fork length 71 millimeters)

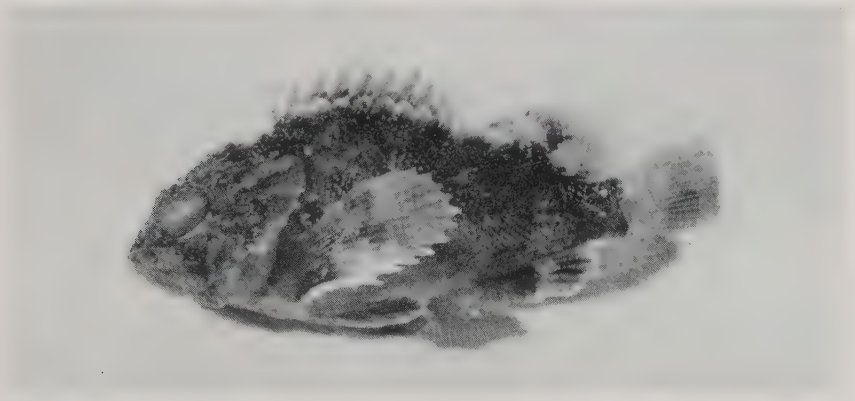
while salinity was 26.4 and 28.0 0/00, respectively. Breder (1948) stated that this is "the most common species of the family" on the Atlantic coast and strays "accidently north to Massachusetts." Nichols and Breder (1926) reported the species as "accidental, October" at New York. The only previous specific record for Long Island, however, appears to be that of a 3-inch specimen collected at Gravesend Bay on October 22, 1897 (Bean, 1903).

Trichiurus lepturus (Linnaeus) Atlantic cutlassfish

This species is known to straggle as far north as Massachusetts, but it is generally encountered offshore. Nichols and Breder (1926) described it as casual or rare in the Long Island-New York area, and it was not recorded by Greeley (1939) or listed by Gordon (1951). On July 6, 1962 a cutlassfish measuring 715 millimeters in total length was captured by haul seine in the surf off Fire Island (at the former Bellport Coast Guard station). Water temperature was 67° F. and the salinity was 30.0 0/00. During 1963 two more specimens were brought to our attention, but these had been captured offshore by trawlers in midsummer. Breder (1932) recorded a larger example (876 millimeters in total length) from Sandy Hook Bay in New Jersey on June 30, 1932 which was the second record for Lower New York Harbor (Bean [1903] reported a small specimen taken from Gravesend Bay in August 1897) and the earliest date for the New York region. At Orient, Latham (1964) recorded several inshore occurrences and the latest date for the region, November 7, 1942.

Scorpaena plumieri (Bloch) Spotted scorpionfish

Although this species is reported to occur at Woods Hole in Massachusetts in some numbers from time to time (Nichols and Breder, 1926), Greeley (1939) was the first to report a specimen from Long Island.



Scorpaena plumieri spotted scorpionfish (total length 39 millimeters)

A second specimen was collected from Wells Creek at Shinnecock Bay on October 8, 1962. The fish measured 39 millimeters in total length. At the time of capture the water temperature was 63° F. and the salinity was 28.8 0/00. One of the authors identified another specimen collected by an amatuer naturalist in Great South Bay in July of 1962. This is an early date for the species but further details are unavailable.

Dactylopterus volitans (Linnaeus) Flying gurnard

Ordinarily considered to be a rare fish in Long Island waters (Nichols and Breder, 1926), 10 specimens were taken between August 8 and October 10 in 1962, five each in Shinnecock and Moriches Bays. The fish ranged in fork length from 73 millimeters on August 8 (the earliest date reported for this area) to 127 millimeters on October 8. Water temperatures over this period changed from 81° to 58° F. and salinities from 23.2 to 28.8 0/00. Greeley (1939) reported a single small specimen (67 millimeters long) taken at Fire Island Inlet on August 22, 1938. This is the only other south-shore record, although there is a report of one from Gravesend Bay (Lower New York Harbor) taken on October 30, 1897 (Bean, 1903). Latham (1919, 1964) reported the largest (7½ inches long) local specimen from Orient on October 28, 1918 and the latest from the same area on November 7, 1938. Arnold (1949), however, recorded two 152-millimeter (fork length) specimens from Woods Hole in Massachusetts on the extraordinary date of November 24, 1948.

Astroscopus guttatus (Abbott) Northern stargazer

Five juvenile stargazers were taken at Mercer's Island in Great South Bay between August 14 and October 16 in 1962. Total length ranged from 44 to 103 millimeters, increasing progressively through the season. Water temperatures ranged from a high of 68° F. in August to a low of 58° F. in late September with salinities of 24.8 to 26.0 0/00. *Astroscopus* is uncommon in Long Island waters, but Breder and Nigrelli (1934) and Gordon (1951) found it fairly numerous in Sandy Hook Bay in New Jersey. Over the years one or two juvenile specimens have been encountered from Jamaica Bay and Great South Bay, but more often larger specimens are caught by rod and reel anglers in the south-shore bays and the adjacent inshore ocean areas.

Anarhichas lupus (Linnaeus) Atlantic wolffish

One specimen, approximately 10 pounds in weight, was taken on hook and line in Fire Island Inlet on April 27, 1963 from the party fishing boat "Angler" out of Captree State Park. This species was listed as rare in the New York area by Nichols and Breder (1926), and the only definite record we can find is that of a 37-inch specimen reported by Latham (1964) as having been taken offshore on the "codfish

grounds" south of Quogue in May 1934. Breder (1948) gave the range of this fish as "south to Cape Cod and rarely to New Jersey", while Bigelow and Schroeder (1953) stated that they had "heard of none caught to the westward and southward of Vineyard Sound at any time during the past half-century". It is apparent that this specimen is at least a new inshore record for New York.

Membras martinica (Valenciennes) Rough silversides

Although Nichols and Breder (1926) reported this species as casual in the vicinity of New York and Breder (1948) considered it "not common north of Virginia", several thousand specimens were taken in seine hauls at Red Cedar Point in Great Peconic Bay on September 4, 18, and 20 in 1963. On September 18, it was more abundant than *M. menidia* taken in the same hauls. Water temperatures on these dates ranged from 62° to 74° F. and salinities from 26.4 to 28.0 0/00. Five specimens, 65 to 110 millimeters in fork length, were collected and preserved. Bean (1901) reported one specimen taken in Mercox Bay on August 1, 1898 and a "few examples" from other south-shore bays

Bothus sp.

A single small specimen (57 millimeters in total length) of this undescribed[4] bothid was seined from Smith Creek at Shinnecock Bay on

Bothus sp. (total length 57 millimeters)

October 8, 1962. Water temperature and salinity were 63° F. and 28.8 0/00, respectively, at the collecting site. Records of the species with

[4] C. R. Robins, personal communication.

which this might be confused, *Bothus ocellatus* (Agassiz), are very sparse in the Northeast. Bean (1901, 1903) collected two small examples of *Platophrys* (=*Bothus*) *ocellatus* at Fire Island Inlet beach on September 30, 1890. He stated that the discovery of this fish in Great South Bay was "entirely unexpected" but his description leaves doubt as to whether it was *ocellatus* or the undescribed form that he encountered. Nichols and Breder (1926) reported *ocellatus* as casual, with several specimens from Woods Hole in Massachusetts, and they noted it as "accidental, September" in New York waters. *Bothus* was not reported by Greeley (1939) despite extensive seining, nor was it collected by Gordon (1949) during 11 weeks of seining on sandy bottoms. The present specimen is the first of this undescribed flatfish to be reported from Long Island.

Stephanolepis hispidus (Linnaeus)[5] Planehead filefish

Although this filefish cannot be considered rare in the Long Island area, it may be extremely scarce or absent during some years while quite common during others. In collections over a wide range of stations on Long Island in 1938, it was found to be locally common at Fire Island Inlet but it was unrecorded elsewhere (Greeley, 1939). During the summer of 1948, Gordon (1949) found juvenile filefish in considerable numbers in late July, taking as many as 50 specimens (all 25 millimeters or less in length) on July 24 but only scattered individuals after July 27. In 1962 it was both common and widely distributed; from July 12 to October 8, a total of 74 specimens ranging from 23 to 105 millimeters in total length were collected from Great South Bay, Moriches Bay, Shinnecock Bay and in the surf off Fire Island. Water temperatures ranged from a high of 81° F. at Shinnecock Bay on August 8 to a low of 60° F. at Moriches Bay on October 8. Salinities varied from 25.0 to 32.1 0/00 at the collecting sites. That this filefish was common in the ocean may be noted from a catch of 30 specimens, 35 to 90 millimeters in total length, seined in one haul through the surf at Old Inlet on Fire Island on August 30. In 1963 this species was nearly absent; only six specimens were recorded from all the foregoing areas between August 27 and October 3. Of these, just two were collected in the surf on August 5. A very small specimen, only 15 millimeters in total length, was taken at Old Fort Pond in Shinnecock Bay on October 3, 1963. Bean (1901) reported the species as occasional in Gravesend Bay, but collected only a single specimen from Great South Bay on August 16, 1898. Latham (1916, 1917) recorded it from extreme eastern Long Island as late as November 8 and November 22.

[5] We follow Berry and Vogele (1961) in the use of *Stephanolepis* as the valid generic name of this species. According to these authors *hispidus* is the only species of the genus to occur at this locale.

Lactophyrs triqueter (Linnaeus) Smooth trunkfish

A single specimen, 9 millimeters in total length, was taken at Timber Point on Great South Bay on July 3, 1962 (water temperature 76° F., salinity 21.6 0/00). Nichols and Breder (1926) regarded this species as rare in late summer and fall and only occasional in New York waters from August to October. On the other hand, Greeley (1939) reported about 70 specimens between 8 and 16 millimeters long taken in Fire Island Inlet in August, indicating that it may be common at times in a suitable environment. Breder (1938) did not include it in the species of fish from New York Harbor (Sandy Hook Bay), but it has been recorded at least once by Latham[3] at Orient.

Lagocephalus laevigatus (Linnaeus) Smooth puffer

The adult smooth puffer is an uncommon but regular species in the waters about Long Island. It is occasionally taken by hook and line fishermen (who know it as "rabbitfish") during the summer months, usually in the inshore ocean, but it has been reported in the bays. Nichols and Breder (1926) considered it rare in fall with dates extending from September 15 to November 5. Gordon (1951) listed it as early as July 22 (1937) and as occasional along the south shore from August to October. Greeley (1939) reported the capture of a very small specimen (67 millimeters long) at Fire Island Inlet on August 8, 1938. Bean (1903) obtained five young (no measurements) at Gravesend Bay in New York Harbor in October 1897. Tracy (1910) reported a 4½-inch specimen from Narragansett Bay in Rhode Island in early August 1905. On September 7, 1962 a 90-millimeter (fork length) smooth puffer was seined from the surf at Old Inlet on Fire Island. The water temperature was 68° F. and the salinity 31.2 0/00. This juvenile was quite distinctly different in coloration from the adult. In formalin it is light gray above, blotched and saddled with dark markings from snout to caudal peduncle, and most nearly resembles the description in Meek and Hildebrand (1928). Latham (1917, 1921) reported the capture of intermediate-sized fish at Orient, i.e., a 6-inch specimen on November 1, 1916 and an 8-inch one on November 5, 1920 which is also the latest date for Long Island.

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POPULATION DYNAMICS OF DEER AT THE SENECA ARMY DEPOT[1]

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ABSTRACT

By 1957 deer had become so numerous on the Seneca Army Depot that they constituted a serious nuisance and had badly depleted the available forage. Hunting was undertaken as a management measure and proved successful in reducing the population to a level where it was compatible with the activities at the Depot and within the carrying capacity of the range. Insofar as possible, all deer removed were examined, and data on sex, age and reproductive condition were recorded. From these, estimates were made of the population trend and composition from year to year. By 1961 the reproductive rate, which was low in 1957, had risen substantially. Average weights and antler size had also increased.

In 1942, the U.S. Army acquired approximately 9,832 acres near the village of Romulus in Seneca County (N.Y.) and established the Seneca Army Depot.[2] A 7-foot fence and a service road were constructed around the perimeter of the Depot. A network of interior roads and railroads, administration buildings, storage buildings and work buildings were constructed. The installation was considered a high security area.

The area has a slight western slope. Snow seldom accumulates to a depth of more than 2 feet, and such depths do not last more than about 3 weeks. A majority of the area is usually blown almost free of snow so that deer are able to graze most of the winter.

Virtually all of the tract had been farmed, but after the Depot was established farming activities ceased. The fields reverted to a succession of grasses, weeds and forbs. However, there has been virtually no invasion of shrubs in the abandoned fields, actively cultivated prior to 1940, except for some local expansion of gray dogwood (*Cornus race-*

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[2] This installation was known as the Seneca Ordnance Depot until 1963.

mosa). Scattered woodlots and hedgerows may comprise 20 per cent of the area. About 7,500 acres constitute deer range.

Browse, as a source of winter food, was almost completely exhausted by about 1954. In some areas there were many young (up to 8 feet tall) red cedars (*Juniperus virginiana*). These were heavily browsed and have remained as small cylinders (4 to 6 inches in diameter) with some foliage behind the severely pruned branches. Ironwood (*Ostrya virginiana*) and even dogwood were browsed. White spruce (*Picea glauca*), planted on the area, was so severely browsed that until 1961 and 1962 little or no annual growth was retained.

Deer on the area were largely confined to grazing, and the rosettes of perennial plants and dead grasses and forbs, which they often ate down to ground level or into the roots, were their major source of food in winter. During winter, from about 1955 through 1958, they frequently dug for the roots of perennial plants, notably elecampane (*Inula Helenium*). There were some large hickory (*Carya ovata*) and black walnut (*Juglans nigra*) trees on the area. The deer ate the nuts of these, including the hulls. The winter of 1961-62 was the only one since about 1954 or 1955 when some nuts and many hulls remained on the ground.

HISTORY OF DEER POPULATION

An estimated 20 to 40 white-tailed deer (*Odocoileus virginianus*) were enclosed when the fence was erected. The 7-foot fence was too low to prevent an occasional large deer from jumping it (either in or out), but interchange with the population outside was negligible.

The deer herd increased rapidly because of the sanctuary-like conditions of the Depot. By the summer of 1954 at least 1,121 were present, and the animals were becoming a nuisance to Depot activities. There were numerous deer-vehicle collisions and the deer were literally eating themselves out of house and home. Winter browse was severely depleted, and the species that remained were of low palatability, i.e., beech, elm, juniper and gray dogwood.

About this time the Army decided something would have to be done to control this deer herd. They enlisted the aid of the Conservation Department to help work out a solution. The management program undertaken provided data on the population dynamics of the deer on the area.

MANAGEMENT

The commanding officer, with the cooperation of Department personnel, reviewed possible removal methods. Because of the nature of the materials stored at the Depot, hunting was considered too risky. It was decided that a trap and transfer program would be undertaken.

TRAPPING

The work was done by Army personnel who built the traps and operated them according to recommendations of Department technicians (Bromley and Severinghaus, 1956). During the winters of 1954-55 and 1955-56, a total of 318 deer were removed from the Depot (Table 1).

TABLE 1. AGE AND SEX OF DEER TRAPPED AT THE SENECA ORDNANCE DEPOT

Year	Male			Female			Total
	Fawn	Adult	Total	Fawn	Adult	Total	
1954–55 . .	6	26	32	5	32	37	69
1955–56 . .	21	99	120	19	110	129	249
Total . . .	27	125	152	24	142	166	318

But this was much less than the number of fawns produced and the population continued to grow (Severinghaus, 1958). The program was reviewed during the summer of 1957, its futility was realized, and another approach was decided upon.

HUNTING

In consequence of the failure of the trap and transfer program, coupled with starvation losses in the winter of 1957, commanding officer agreed to experimental hunting on the Depot in 1957. Because of the strict safety and security measures required, all hunting would be done by Depot personnel or under the supervision of Depot personnel. It was also decided that hunting would be done only with shotguns loaded with slugs. The Department issued a permit[3] allowing authorized personnel to take deer of either sex from October through January except during the regular big game season in central and western New York and special seasons that might be declared. During such regular seasons those authorized to hunt were required to have a current unfilled big game license and the general regulations as to deer that might be taken were in effect. During the special seasons such license was also required, but deer of either sex could be taken. When a license was required successful hunters could keep their deer.

Hunting during the fall of 1957 was divided into three phases: a preseason hunt (under the permit) concentrated on adult females; the

[3] A similar permit has been issued annually since that time. Most hunting under these permits has been done prior to the regular big game season and most of the deer taken have been distributed to charitable institutions.

regular big game season; and one day of hunting for deer of either sex on the last day of the big game season. The same pattern was followed in 1958. In 1959 there was a preseason hunt, but no hunting was done during the big game season because of public opinion that a buck short-

Table 2. Age and Sex of Deer Removed by Hunting at the Seneca Ordnance Depot

Source of data*	Male			Female			Total
	Fawn	Adult	Total	Fawn	Adult	Total	
1957–58							
Current record	28	604	632	28	231	259	891
Dead deer survey	15	119	134	14	88	102	236
Total	43	723	766	42	319	361	1,127
1958–59							
Current record	43	197	240	38	237	275	515
Dead deer survey	6	39	45	5	42	47	92
Total	49	236	285	43	279	322	607
1959–60							
Current record	59	87	146	56	293	349	495
Dead deer survey	5	18	23	6	54	60	83
Total	64	105	169	62	347	409	578
1960–61							
Current record	151	195	346	152	256	408	754
Dead deer survey	25	61	86	25	98	123	209
Total	176	256	432	177	354	531	963
1961–62							
Current record	48	65	113	45	105	150	263
1957–58 to 1961–62							
Total	380	1,385	1,765	369	1,404	1,773	3,538

* "Current record" means specimen was examined during season hunting was done; "dead deer survey" means data were derived from specimen found during dead deer survey in spring of 1961.

age existed within the Depot area. There were, however, seven postseason hunts for deer of either sex on Saturdays in December and January (1960). In 1960-61 there were several preseason hunts, the regular buck season, and five 1-day postseason hunts in December and January. In 1961-62 there was no preseason hunt, but bucks were hunted during the regular big game season and there were four postseason hunts for deer of either sex.

Because of the degree of control over hunting activities, it was possible to check all deer taken and recovered. Each year, however, some deer were killed but not recovered. Hunters were requested, if they found such deer, to remove them to a road so they could be collected. This voluntary system was not perfect, but it did provide information on the age and sex of deer killed but wasted. Also, in the spring of 1961, about a third of the Depot area was surveyed for dead deer. Of the 292 remains found, the number ascribable to hunting each year was determined and totals for the area as a whole were calculated. The data are given in Table 2.

EFFECT ON DEER POPULATION

The 318 deer that were trapped and removed from the Depot did not check the population increase, and in the winter of 1956-57 the first recorded starvation losses occurred. Somewhat greater winter mortality occurred the following year, but after that such losses were small. The data (Table 3) comprise in part the records of deer found and disposed of by Depot personnel and in part the calculated figures derived from the dead deer survey in 1961. That starvation losses became negligible despite the fact that forage depletion was observed as early as 1957 indicates that the hunting program was effective in controlling deer abundance.

POPULATION DYNAMICS

The deer management program on the Depot area was begun in February 1954. In addition to the numbers removed by trapping and hunting or found dead from other causes, data were obtained each year until 1961 pertaining to sex and age ratios and rates of reproduction. From these, tables have been prepared showing the changes in population composition that have taken place.

Rates of Reproduction

Beginning in 1957 when hunting was permitted, the reproductive tracts of virtually all female deer taken and recovered were collected. The pregnancy rates and potential fawn production were determined from examination of the ovaries and uteri. The method followed that of Cheatum and Severinghaus (1950) as slightly modified by Severinghaus (1954). Because fawns breed so late in the year (December-

Table 3. Age and Sex of Deer Recorded as Dying of Starvation at the Seneca Ordnance Depot

Source of data *	Male			Female			Total
	Fawn	Adult	Total	Fawn	Adult	Total	
1957							
Current record	45	11	56	55	14	69	125
Dead deer survey	22	10	32	28	11	39	71
Total	67	21	88	83	25	108	196
1958							
Current record	85	..	85	115	18	133	218
Dead deer survey	43	..	43	58	19	77	120
Total	128	..	128	173	37	210	338
1959							
Current record	7	..	7	5	..	5	12
Dead deer survey	3	..	3	3	..	3	6
Total	10	..	10	8	..	8	18
1960							
.....	..	..	..	..	..	..	..
1961							
Current record	3	..	3	4	2	6	9
1957–1961							
Total	208	21	229	268	64	332	561

* "Current record" means specimen was examined during season starvation took place; "dead deer survey" means data were derived from specimen found during dead deer survey in spring of 1961.

January usually) it was not possible to obtain good current pregnancy data for this age group. Therefore, the ovaries of females 1½ years old were examined for evidence of a pregnancy the previous year (corpus albicans), and the presence or absence of milk in the udder was recorded for deer taken in the fall. All pregnancy rates and embryo counts were

tabulated according to the age[4] of the dam. This was necessary in order to determine how early in life reproductive ability started and when full reproductive potential was attained.

Both types of data were obtained for 1959-60, 1960-61 and 1961-62 when hunting was done in January (Table 4). For the specimens collected in 1957 and 1958, however, only corpora lutea counts could be

TABLE 4. RATIO OF EMBRYOS TO CORPORA LUTEA FOR DEER EXAMINED AT THE SENECA ORDNANCE DEPOT

Year	Number corpora lutea	Number embryos	Embryos per 100 corpora lutea
1959–60	257	235	91.44
1960–61	248	224	90.32
1961–62	159	151	94.97
Total	664	610	91.87

TABLE 5. REPRODUCTIVE RATES OF DEER AT THE SENECA ORDNANCE DEPOT*

Year	Age at parturition		
	1 year	2 years	3 years and older
1957–58	0.00	0.99	1.57
1958–59	0.00	1.15	1.79
1959–60	0.04	1.07	1.82
1960–61	0.05	1.21	1.74
1961–62	0.20	1.52	1.99

* Average number of embryos per female examined.

obtained because the hunting seasons were held from October through December. In order to derive values for these years the average propor-

[4] Tooth replacement and wear criteria (Severinghaus, 1949) were used to determine age. However, the wear pattern of the teeth of deer from the Depot was slightly different from the typical one published. The rate of wear on the permanent premolars and molars was slightly faster because these deer often grubbed for food in the frozen ground from late fall until late spring and apparently picked up dirt in the process. In general, the usual 10-year wear possibly occurred in about 9 years, but no known-age specimens were available to prove this. One man with wide experience in using this technique, John E. Tanck, assigned ages to most of the deer for which data were recorded.

tion of embryos to corpora lutea for the other three years was used to reduce the corpora lutea counts to embryo counts.

From these data the reproduction rates (embryos per female) were determined (Table 5). The rate was low in 1957-58 after the heavy starvation losses of the previous winter, but it increased substantially from 1958-59 to 1961-62.

There are no data on rates of reproduction for this specific area or for Seneca County when the deer population was in balance with its food supply. However, a general survey of central and western New York was made by Cheatum and Severinghaus (1950). In a sequel, Severinghaus (1954) reported that 40.9 per cent of the fawns were bred and averaged 47 embryos per 100 females, while among the adults 97.2 per cent were bred and averaged 178 embryos per 100 females.

Population Composition

From the records of deer trapped, killed or found dead the composition of the population on the Depot area each year was estimated. The numbers of deer known to have been removed each year were tabulated according to sex and year of birth (Table 6). These figures are minimal because unrecorded losses also occurred as a result of vehicle collisions, poaching and other causes. Thus the total number removed for any one year class represents the minimum number of fawns that must have been born in that year. And the number remaining in each subsequent year may be derived from the record of the number removed from year to year. In this way the figures were projected to depict the minimum numbers of each age and sex in the population each summer from 1947 to 1961 (Table 7).

It is recognized that the actual population was greater than shown in this table, especially for the years prior to 1955 when sample data were first obtained. No deer born before 1945 were represented in the records. Obviously, such deer had been present, but virtually all of them had died before sampling began. It is reasonable to assume that in 1947, in addition to many of their progeny, some deer from the original population of 1942 were still present as 6-year-old or older animals. Obviously, there also were losses in the various age groups between 1947 and 1954. Furthermore, the method used to derive these population estimates predetermined that the number removed during the last year would equal the number estimated to have been present at that time, i.e., there would be none left. But many deer did remain in 1962; the recorded take by hunting was 144. Nevertheless, the figures in Table 7 represent the minimum number of deer that were present as documented by records of deer removed, and it is felt that for the years 1955 through 1960 they broadly reflect the actual population composition.

TABLE 6. SEX-FREQUENCY DISTRIBUTION BY YEAR CLASS FOR DEER KNOWN TO HAVE BEEN REMOVED FROM POPULATION AT THE SENECA ORDNANCE DEPOT FROM 1955 TO 1961 ACCORDING TO MANNER OF REMOVAL

Year class	1955* winter trapped		1956* winter trapped		1957				1958				1959				1960 fall hunted		1961				1955–1961		
					winter starved		fall hunted		winter starved		fall hunted		winter starved		fall hunted				winter starved		fall hunted				
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Total
1945	..	1	1	1	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	1	2	3
1946	..	..	..	1	6	7	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	6	8	14
1947	..	1	1	..	6	6	13	2	..	2	..	2	..	..	..	..	..	..	..	..	..	..	20	13	33
1948	..	1	..	3	4	4	5	3	..	4	..	3	..	..	..	..	..	..	..	..	..	..	9	18	27
1949	2	3	3	5	2	4	7	4	..	3	..	1	..	..	..	..	..	..	..	..	..	..	14	20	34
1950	3	3	6	10	2	3	4	6	..	6	..	1	..	..	..	6	..	..	..	..	..	..	15	35	50
1951	5	5	12	11	1	1	27	9	..	8	2	9	..	..	..	3	..	..	..	..	..	..	47	46	93
1952	5	8	18	18	..	..	56	34	..	..	..	20	..	..	..	18	..	11	..	1	..	1	79	111	190
1953	11	10	18	27	..	..	101	29	..	..	7	22	..	..	2	25	4	21	..	..	..	2	143	136	279
1954	6	5	40	34	..	..	131	60	..	..	13	39	..	..	4	35	5	24	..	..	..	2	199	199	398
1955	..	..	21	19	..	..	109	88	..	..	36	55	..	..	2	45	7	27	..	1	1	4	176	239	415
1956	..	..	..	..	67	83	270	84	..	14	73	83	..	..	4	52	15	35	..	..	1	8	430	359	789
1957	..	..	..	..	..	..	43	42	128	173	105	44	..	..	8	53	36	42	..	..	2	11	322	365	687
1958	..	..	..	..	..	..	..	..	..	..	49	43	10	8	85	110	49	91	..	..	5	14	198	266	464
1959	..	..	..	..	..	..	..	..	..	..	..	..	..	..	64	62	140	103	..	..	8	29	212	194	406
1960	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	176	177	3	4	48	34	227	215	442
1961	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	48	45	48	45	93
Total	32	37	120	129	88	108	766	361	128	210	285	322	10	8	169	409	432	531	3	6	113	150	2,146	2,271	4,417

* Age distribution based on data recorded during hunting season of 1957.

Table 7. Minimum Deer Population According to Age and Sex at the Seneca Ordnance Depot from 1947 to 1961 Based on the Numbers Known to Have Been Removed *

Year	Age and sex																								
	Fawn§		1 year		2 years		3 years		4 years		5 years		6 years		7 years		8 years		9 years		10 years		Older		All ages		
	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	M	F	Total
1947..	20	13	6	8	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	27	23	50
1948..	9	18	20	13	6	8	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	..	36	41	77
1949..	14	20	9	18	20	13	6	8	1	2	..	..	..	..	..	..	..	..	..	..	..	..	..	..	50	61	111
1950..	15	35	14	20	9	18	20	13	6	8	1	2	..	..	..	..	..	..	..	..	..	..	..	..	65	96	161
1951..	47	46	15	35	14	20	9	18	20	13	6	8	1	2	..	..	..	..	..	..	..	..	..	..	112	142	254
1952..	79	111	47	46	15	35	14	20	9	18	20	13	6	8	1	2	..	..	..	..	..	..	..	..	191	253	444
1953..	143	136	79	111	47	46	15	35	14	20	9	18	20	13	6	8	1	2	..	..	..	..	..	..	334	389	723
1954..	199	199	143	136	79	111	47	46	15	35	14	20	9	18	20	13	6	8	1	2	..	..	..	..	533	588	1,121
1955..	176	239	193	194	132	126	74	103	42	41	12	32	12	17	9	17	20	12	6	8	1	1	..	..	677	790	1,467
1956..	430	359	155	220	153	160	114	99	56	85	30	30	6	22	9	12	9	14	19	12	6	7	..	..	987	1,020	2,007
1957..	322	365	363	276	155	220	153	160	114	99	56	85	29	29	4	19	7	8	5	10	13	6	..	..	1,221	1,277	2,498
1958..	198	266	151	150	93	178	46	132	22	100	13	70	..	51	2	12	..	7	..	1	..	3	..	2	525	972	1,497
1959..	212	194	139	215	46	106	20	95	10	77	9	61	6	48	..	31	..	3	..	6	..	..	..	..	442	836	1,278
1960..	227	215	148	132	54	105	38	53	16	43	8	32	5	26	4	23	..	13	..	..	..	..	..	..	500	642	1,142
1961..	48	45	48	34	8	29	5	14	2	11	1	8	1	4	..	2	..	2	..	1	..	..	..	..	113	150	263

* The data represent the population composition each year at the time fawns were born.

§ The sex ratio for the total number of fawns (2,139 males and 2,261 females) is 94.6 : 100. If this ratio had been the average of 105.2 : 100 (Severinghaus and Cheatum, 1956), then 262 male fawns would be unaccounted for.

Production and Survival

As has been pointed out, the figures in Table 7 represent deer that can be accounted for by the specimens recorded, and the population totals for the various years are less than the number of deer that actually were present on the area. The increment of fawns each year is the sum of the individuals of that year class that were known ultimately to have been removed.

Another estimate of the number of fawns produced was made by applying the reproductive rates recorded (Table 5) to the number of females as given in Table 7. The figures derived in this way represent fawns "in utero" and should be higher than those based on deer ultimately removed. They are given in Table 8 for the years 1950 to 1959. This period was arbitrarily selected as constituting the five years before and the five years after population control was undertaken in the winter of 1954-55.

Specific data for reproductive rates at the Depot prior to 1958 were not available. But the rate increased from year to year after that as the population was reduced. Also, it seemed probable that it had reached its lowest point about 1957 when winter starvation first became serious and that earlier it had been substantially higher. Therefore, in Table 8, the values recorded for 1958 were used for 1957 and those recorded for 1962 were used for the previous years. For the latter period, the average of the values for adult females was virtually identical to that reported by Severinghaus (1954) for western New York in general; however, that for fawns was less than half as great.

The known numbers of fawns ultimately removed are also given in Table 8. Since they represent deer that had lived for various periods of time before being removed, comparison with the probable number of fawns produced reflects survival. For the period 1950 to 1954, before management was begun, this was 88.5 per cent. However, survival between the sexes was not equal. Of the 1,010 deer taken that had been produced in those years, 483 were male and 527 were female (Table 7) —a ratio of 91.7 to 100. If it is assumed that the sex ratio at birth approximated the general average of 106.2 males to 100 females reported by Severinghaus and Cheatum (1956), then for the 527 females taken there was a loss among the corresponding males of 77, or approximately 14 per cent of the number produced, between birth and the time of removal. If the same sex ratio at birth is applied to the probable number of fawns produced (1,141), there should have been 588 males and 553 females. The known numbers taken were 105 and 26 less, respectively, and indicate a differential mortality after birth of four males per female.

The same comparisons were made for the period 1955 to 1959. Survival, in terms of the difference between the probable number of

fawns produced and the known number subsequently taken, was 71.3 per cent. Of the 2,761 fawns ultimately taken, 1,338 were male and 1,423 were female (Table 7)—a ratio of 94.0 to 100. Based on the average sex ratio of 106.2 males to 100 females at birth, there was a loss among the males corresponding to the 1,423 females taken, of 173, or approximately 11 per cent of the number produced, between birth and the time of removal. If the same sex ratio is applied to the probable number of fawns produced (3,874), there should have been 1,996 males and 1,878 females. The known numbers taken were 658 and 455 less, respectively, and indicate a differential mortality after birth of about one and a half males per female.

Both these approaches indicate unaccounted for losses that were greater among males than among females. But the method used precludes any estimate of such losses among females. On the other hand, using the known numbers of fawns ultimately removed and the probable numbers produced, of both sexes, as shown in Table 8 gives combined losses of 11 per cent for the 1950-1954 period and 29 per cent for the 1955-1959 period. That this value increased while the differential mortality between the sexes apparently decreased suggests that there were greater losses of this sort among females during the second period than the first.

No direct evidence was obtained to indicate the causes of the additional losses. Yet it seems doubtful that such a number of deer (1,000 or more) could have gone completely unnoticed if they had lived to be 6 months or older. Therefore, it is postulated that most of these deer died soon after birth and decomposed so rapidly and completely that their remains were not found. It is further postulated that the greater losses among males may have also involved the illegal removal of prime antlered bucks during the fall. That the ratio of males per female in these losses declined from the first 5-year period to the second might be attributed to the more frequent presence of Conservation Department personnel on the area after 1954.

DISCUSSION

By 1957 deer had become so numerous on the Seneca Army Depot that they constituted a serious nuisance and had badly depleted the available forage. Hunting was undertaken as a management measure and proved successful in reducing the population to a level where it was compatible with the activities at the Depot and within the carrying capacity of the range. Associated with this were changes in population dynamics.

In five years, during which the population was progressively reduced, reproduction rates rose steadily. In 1957 there were no fawns breeding, and the average number of embryos was 0.99 for yearling does

TABLE 8. COMPARISON OF THE PROBABLE NUMBERS OF FAWNS PRODUCED AND THE NUMBERS KNOWN TO HAVE BEEN REMOVED AT THE SENECA ARMY DEPOT

Year	1-year-old females*			2-year-old females*			3-year-old and older females*			Total	
	Number	Reproductive rate	Probable fawns produced	Number	Reproductive rate	Probable fawns produced	Number	Reproductive rate	Probable fawns produced	Probable fawns produced	Known number ultimately removed
1950	20	0.20	4	18	1.52	27	23	1.99	46	77	50
1951	35	0.20	7	20	1.52	30	41	1.99	82	119	93
1952	46	0.20	9	35	1.52	53	61	1.99	121	183	190
1953	111	0.20	22	46	1.52	70	96	1.99	191	283	279
1954	136	0.20	27	111	1.52	169	142	1.99	283	479	398
1955	194	0.20	39	126	1.52	192	231	1.99	460	691	415
1956	220	0.20	44	160	1.52	243	281	1.99	559	846	789
1957	276	0.00	0	220	0.99	218	416	1.57	653	871	687
1958	150	0.00	0	178	0.99	176	378	1.57	593	769	464
1959	215	0.00	0	106	1.15	122	321	1.79	575	697	406

* Age at parturition.

and 1.57 for adult does. By 1961 at least 20 per cent of the fawns were breeding, and the average number of embryos was 1.52 and 1.99 for yearling and adult does, respectively. The proportion of doe fawns breeding probably was even higher because they normally breed from one to two months later than older does; thus some of those killed in December and January, that had not bred, might have if they had lived.

As the population was reduced, average weights of the deer increased. In the fall of 1961 fawns averaged 11 pounds heavier than in 1957. Yearling males averaged 14.6 pounds, and yearling females 10 pounds, heavier. The average for older males was 2 pounds less, but the mean age of this group was much lower in 1961 than in 1957. Older females averaged 7 pounds heavier in 1961.

Antler size also improved. In 1957 yearlings averaged 3.4 points, in 1961 they averaged 4.2. The average number of points for 2½-year-old bucks increased from 6.5 to 8.0, and that for older bucks increased from 8.2 to 9.2. Average beam diameter increased from 16.18 to 18.16 millimeters for yearlings and from 23.00 to 24.29 millimeters for 2½-year-old deer. For older deer it decreased from 29.54 to 29.00 millimeters, but their mean age was lower in 1961.

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THE SPORT FISHERY IN THE SURF ON THE SOUTH SHORE OF LONG ISLAND FROM JONES INLET TO SHINNECOCK INLET[1]

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ABSTRACT

The sport fishery in the surf between Jones Inlet and Shinnecock Inlet was studied from April through November each year from 1961 through 1963. During this period the number of anglers increased markedly. The majority (over 70 per cent each year) were concentrated between Jones Inlet and Fire Island Inlet, and these anglers caught the most fish and the greatest variety. The catch was dominated by four species: northern puffer, striped bass, northern kingfish and bluefish; but most anglers sought striped bass success for which was highest in spring and fall. Data taken between Jones Inlet and Fire Island Inlet indicated that night anglers generally had higher catches per effort for striped bass and bluefish, the principal species caught, than their daytime counterparts. Variations in abundance and fishing success for the other species are discussed. Because of the increasing popularity of surf fishing in this area, there is need for better access to the beaches east of Fire Island Inlet.

The approximately 60 miles of barrier beach from Jones Inlet to Shinnecock Inlet affords some of New York's best sport fishing in the surf. This fishery was studied from April through November each year from 1961 through 1963 to determine the number of anglers involved, their degree of success and the nature of their catch. The area is naturally divided into three smaller areas by Fire Island Inlet and Moriches Inlet (Figure 1).

The western area, Jones Inlet to Fire Island Inlet, is about 15 miles long and comprises Jones Beach State Park and several town-owned public beaches. Easily accessible over modern highways, it lies within an hour's drive of New York City and is heavily used by bathers, fish-

Figure 1. Map of Long Island showing location and extent of the areas studied.

ermen, picnickers and others seeking outdoor recreation. Beach buggies are prohibited at Jones Beach State Park, but there is limited access

[1] A contribution of Federal Aid in Fish and Wildlife Restoration Project F-15-R.

for them at Cedar Beach (Town of Babylon) although this usage is generally discouraged.

Fire Island, the central area lying between Fire Island Inlet and Moriches Inlet, is about 30 miles long. There are no roads and access, mostly by ferryboat, is limited. The island has two large public beaches. Fire Island State Park, on the western end, could be reached at the time of this study only by ferry (no vehicles) and only during the summer, but a bridge from Captree State Park to parking lots there was opened in the spring of 1964. Smith Point County Park, near the eastern end, is reached by toll bridge. Beach buggies had, at the time of study, limited access to all of Fire Island. Ordinances recently enacted by the Towns of Brookhaven and Islip, ban the use of beach buggies by anglers west of Smith Point County Park from June 1 through September 30.

The eastern area, Moriches Inlet to Shinnecock Inlet, is about 15 miles long and easily reached over paved roads, but access to the beach is limited. Most of the area is privately owned. The few public beaches are, for the most part, small, poorly developed and restricted to local town or village residents during the summer.

METHODS

Information was obtained by personal interview from 8,457 surf anglers who fished during the day between Jones Inlet and Shinnecock Inlet and from 2,401 surf anglers who fished at night between Jones Inlet and Fire Island Inlet concerning their total catch and its species composition, their catch per effort (fish per angler per trip), and their preference for different species. During the day, data were recorded from anglers who fished at least 4 hours which were considered to be the minimum for an angler trip. Night anglers were interviewed between 6:00 and 11:30 p.m. at the conclusion of their trip, but time fished and fish landed before 5:00 p.m. were not recorded. In either case, only those fish kept by the anglers were recorded.

Aerial censuses, randomly distributed by season, weekdays and weekend days (holidays were considered as weekend days) were flown from April through November. There were 32 flights scheduled each year, but in each of the years 1962 and 1963 one flight was cancelled. The total number of day anglers each month was estimated from these data. Estimates of total catch for all species combined and for individual species were derived by the methods outlined by Briggs (1962). Since airplane censusing at night was impossible, no expansion was made of the interview data from the night fishery.

THE SURF FISHERY IN GENERAL

Little information on the surf fishery was obtained in the 1938 survey of the salt waters of Long Island (Westman, 1939). Striped bass *(Roccus saxatilis)*, weakfish *(Cynoscion regalis)* and bluefish *(Pomato-*

mus saltatrix) were mentioned as being sought by surf anglers. Bluefish were said to be "extremely scarce during the 1938 season". Weakfish catch records did not include the surf fishery (Nesbit, 1939). Neville *et al.* (1939) gave no records or estimates of striped bass caught by sport fishermen.

Briggs (1962) found the sport fishery in the surf from Jones Inlet to Fire Island Inlet to be rapidly expanding from 1956 through 1960 with respect to anglers involved and fish caught. The catches were dominated by northern kingfish *(Menticirrhus saxatilis),* striped bass and bluefish. No other species were sought, and few fish of other species were taken incidentally by the surf anglers.

The data collected from 1961 through 1963 show that the increase of anglers between Jones Inlet and Fire Island Inlet continued (Table

TABLE 1. ESTIMATED NUMBERS OF ANGLERS FISHING IN THE SURF FROM JONES INLET TO SHINNECOCK INLET

Area	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Total	
									Number	Per cent
1961										
Jones Inlet to Fire Island Inlet...	490	1,387	1,513	3,371	2,372	2,265	1,179	1,115	13,692	73
Fire Island.....	40	161	186	539	817	590	241	205	2,779	15
Moriches Inlet to Shinnecock Inlet...	140	399	198	609	433	250	201	110	2,340	12
Total.....	670	1,947	1,897	4,519	3,622	3,105	1,621	1,430	18,811	100
1962										
Jones Inlet to Fire Island Inlet...	1,530	3,374	2,033	2,595	1,811	2,890	1,037	860	16,130	72
Fire Island.....	54	351	317	778	513	725	370	140	3,248	14
Moriches Inlet to Shinnecock Inlet...	108	334	446	682	703	440	187	250	3,150	14
Total.....	1,692	4,059	2,796	4,055	3,027	4,055	1,594	1,250	22,528	100
1963										
Jones Inlet to Fire Island Inlet...	2,220	3,023	2,600	2,460	3,627	2,085	1,318	969	18,302	73
Fire Island.....	346	502	460	737	758	630	379	306	4,118	16
Moriches Inlet to Sninnecock Inlet...	128	175	510	544	561	395	201	243	2,757	11
Total.....	2,694	3,700	3,570	3,741	4,946	3,110	1,898	1,518	25,177	100

Table 2. Proportion (in per cent) of Surf Anglers Each Month Who Used Bait and Who Used Lure*

Area and type of bait	April	May	June	July	Aug.	Sept.	Oct.	Nov.
1961								
Jones Inlet to Fire Island Inlet§								
Bait	91.9	86.4	70.8	76.4	78.3	37.1	17.6	13.5
Lure	22.6	22.3	60.0	38.2	47.0	76.9	95.9	95.3
Fire Island								
Bait	100.0	71.4	41.7	50.0	45.5	50.0	17.2	3.8
Lure	100.0	28.6	83.3	82.6	61.4	67.3	94.3	100.0
Moriches Inlet to Shinnecock Inlet								
Bait	100.0	61.9	42.9	48.7	53.8	30.0	2.5	14.3
Lure	0.0	38.1	76.2	53.9	72.3	80.0	97.5	85.7
1962								
Jones Inlet to Fire Island Inlet								
Bait (day)	100.0	67.2	84.2	69.3	74.4	35.4	52.0	19.8
Lure (day)	0.0	42.5	35.5	62.5	45.2	77.2	64.2	80.2
Bait (night)	100.0	73.8	28.9	33.9	27.7	24.1	25.2	6.2
Lure (night)	0.0	32.5	78.3	83.1	76.8	84.9	84.7	98.5
Fire Island								
Bait	8.9	70.3	55.7	47.9	51.1	29.3	39.4	30.8
Lure	95.6	60.4	91.8	80.6	65.4	86.6	80.3	84.6
Moriches Inlet to Shinnecock Inlet								
Bait	100.0	100.0	14.9	56.5	66.1	22.9	27.5	50.0
Lure	100.0	40.0	91.5	72.5	47.7	100.0	95.0	86.4
1963								
Jones Inlet to Fire Island Inlet								
Bait (day)	92.2	95.0	49.8	57.5	78.6	34.3	44.0	41.3
Lure (day)	8.8	11.4	61.2	51.1	53.4	65.7	57.8	71.7
Bait (night)	100.0	70.0	41.8	57.2	47.4	18.4	33.8	20.9
Lure (night)	0.0	48.8	85.1	61.1	71.1	96.1	84.4	84.9
Fire Island								
Bait	91.8	100.0	36.5	22.0	26.2	3.8	25.0	17.2
Lure	11.5	10.6	73.0	92.7	89.0	100.0	100.0	96.6
Moriches Inlet to Shinnecock Inlet								
Bait	90.9	76.5	14.3	31.5	24.0	17.5	37.5	16.7
Lure	18.2	35.3	85.7	77.5	80.2	90.0	87.5	88.9

* Combined percentages of those using bait and those using lure usually exceed 100 because anglers often used both on the same trip.

§ Data taken only during day in 1961.

1) and that there was an increase over the other parts of the area from Jones Inlet to Shinnecock Inlet as well. However, the section between Jones Inlet and Fire Island Inlet consistently attracted more than 70 per cent of all the surf anglers during these years even though this stretch of beach constituted only one fourth of the total area studied. The more intensive use of this section was probably due to its nearness to New York City and the easy accessibility of its beaches.

During the spring (April and May), most of the surf anglers in all the areas used bait (nereid and glycerid worms, clams, squid, etc.) rather than artificial lures (Table 2). During the day, bait was generally preferred throughout the summer by the surf anglers between Jones Inlet and Fire Island Inlet. In September in that area, most of the day anglers switched to the use of artificial lures. The lower proportions of anglers using bait in that area in June and July of 1963 as compared with the same months of 1961 and 1962 may have been a result of the increased abundance of northern puffer *(Sphaeroides maculatus)*. In the other areas (Fire Island and the area between Moriches Inlet and Shinne-

TABLE 3. AVERAGE NUMBERS OF ANGLERS OBSERVED AT FOUR SELECTED BEACHES BETWEEN JONES INLET AND FIRE ISLAND INLET

Beach	Time	April	May	June	July	Aug.	Sept.	Oct.	Nov.
				1962					
Cedar Beach	Day	23.6	26.5	3.4	12.9	11.3	7.7	9.8	10.3
	Night	27.0	29.4	12.0	20.5	18.8	41.5	30.3	8.3
Gilgo Beach	Day	8.0	6.0	1.0	5.7	7.0	12.4	4.0	1.4
	Night	*	14.7	8.0	21.0	4.0	31.5	7.5	1.0
Jones Beach (parking field No. 9)	Day	1.0	16.3	15.7	13.9	14.6	16.3	12.3	4.1
	Night	*	11.3	7.5	*	13.0	32.5	23.5	8.0
Jones Beach (West End Beach)	Day	14.5	3.0	15.6	21.0	27.8	19.0	6.0	4.5
	Night	*	*	12.0	53.5	16.0	33.0	16.5	6.5
				1963					
Cedar Beach	Day	67.5	29.5	13.6	9.3	7.3	9.4	8.5	9.2
	Night	36.0	24.3	26.3	23.0	37.3	31.0	44.5	31.7
Gilgo Beach	Day	19.5	13.3	5.3	5.1	4.3	2.5	2.7	3.2
	Night	*	43.5	9.0	9.5	17.0	5.0	4.7	2.5
Jones Beach (parking field No. 9)	Day	24.0	22.0	16.6	23.3	18.6	7.9	7.2	5.0
	Night	*	27.0	26.5	65.5	54.5	2.0	13.7	14.0
Jones Beach (West End Beach)	Day	20.7	21.0	11.3	21.8	14.6	6.5	4.2	3.0
	Night	*	22.0	36.5	16.5	23.0	28.0	15.0	14.0

* No observations made.

cock Inlet) and at night between Jones Inlet and Fire Island Inlet, the anglers switched from bait to artificial lures in June. The most intensive use of artificial lures was from September through November. There were times, particularly in the summer, when many surf anglers used both bait and artificial lures during the same trip.

There was an indication that more anglers fished the surf between Jones Inlet and Fire Island Inlet at night than during the day (Table 3). This was particularly noticeable at Cedar Beach and Jones Beach in the summer and fall. The lack of aerial censuses at night made it impossible to fully substantiate the data derived from interviews so that it cannot be stated definitely that night fishing exceeded day fishing. That fewer anglers fished at Cedar Beach in the summer than during the spring and fall may have been due to the restriction of this beach to residents of the Town of Babylon from late May through early September. The high number of anglers at the West End Beach part of Jones Beach during July of 1962 was probably related to the opening of a new parking lot nearer Jones Inlet early that month. The generally greater number of anglers observed at the beaches at night in 1963 than in 1962 indicates that the night surf fishery was increasing.

It was common practice for surf anglers to seek more than one species. Analysis of the species composition of their catch showed a dominance of northern puffer, striped bass, northern kingfish and bluefish (Table 4). Except for the increase of northern puffer, the species composition was basically the same as found in the period 1956-1960 (Briggs, 1962) for the area between Jones Inlet and Fire Island Inlet. The greater variety of species taken between Jones Inlet and Fire Island Inlet than in the other areas may have been an effect of the greater angler activity in that area and the wider use of bait there.

There has been a decline in the catch of northern kingfish since 1961. Between Jones Inlet and Fire Island Inlet the number taken in 1963 was less than one-fourth the 1961 catch; on Fire Island it was less than one-fifth. The increase of northern puffer in the catches was striking. Between Jones Inlet and Fire Island Inlet the number taken in 1962 was more than eight times that in 1961, and on Fire Island it was over 18 times greater. This species was neither sought nor desired by the surf anglers, yet it was the most frequently taken species in 1962 and 1963. Most of the puffer were taken in May, June and July. There appears to have been some relationship between the increased catches of puffer and the declining catches of kingfish. Both were caught only on bait, and the puffer apparently took the baits offered more readily than the kingfish. There were many complaints from surf anglers about puffers "stealing bait." This appears to have discouraged some anglers from using bait, resulting in lower catches of kingfish.

Striped bass catches between Jones Inlet and Fire Island Inlet in-

TABLE 4. SPECIES COMPOSITION OF THE SURF CATCH

Species	Jones Inlet to Fire Island Inlet			Fire Island			Moriches Inlet to Shinnecock Inlet		
	1961	1962	1963	1961	1962	1963	1961	1962	1963
Striped bass									
Number	4,311	4,774	3,993	581	693	2,090	528	960	798
Per cent	38.3	21.6	27.2	21.5	14.8	47.5	30.6	26.0	40.8
Northern kingfish									
Number	4,544	2,873	1,108	1,369	404	266	178	164	84
Per cent	40.3	13.0	7.6	50.7	8.6	6.0	10.3	4.4	4.3
Bluefish									
Number	514	4,921	1,099	386	678	426	381	805	617
Per cent	4.6	22.3	7.5	14.3	14.4	9.7	22.0	21.8	31.5
Northern puffer									
Number	1,009	8,895	7,498	134	2,503	1,153	285	1,382	390
Per cent	9.0	40.3	51.2	5.0	53.3	26.2	16.5	37.4	19.9
Summer flounder									
Number	666	375	54	201	307	15	294	224	45
Per cent	5.9	1.7	0.4	7.4	6.5	0.3	17.0	6.1	2.3
Winter flounder									
Number	108	161	880	0	97	449	0	115	23
Per cent	1.0	0.7	6.0	0.0	2.1	10.2	0.0	3.1	1.2
Weakfish									
Number	44	29	15	0	5	0	0	10	0
Per cent	0.4	0.1	0.1	0.0	0.1	0.0	0.0	0.3	0.0
Scup									
Number	0	0	0	0	3	0	43	29	0
Per cent	0.0	0.0	0.0	0.0	0.1	0.0	2.5	0.8	0.0
Black sea bass									
Number	17	5	0	27	6	0	12	0	0
Per cent	0.2	tr.	0.0	1.0	0.1	0.0	0.7	0.0	0.0
Tautog									
Number	23	0	0	0	0	0	7	10	0
Per cent	0.2	0.0	0.0	0.0	0.0	0.0	0.4	0.3	0.0
Silver perch									
Number	21	0	7	0	0	0	0	0	0
Per cent	0.2	0.0	tr.	0.0	0.0	0.0	0.0	0.0	0.0
Hake *									
Number	0	37	0	0	0	0	0	0	0
Per cent	0.0	0.2	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Atlantic menhaden									
Number	13	0	0	0	0	0	0	0	0
Per cent	0.1	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Windowpane									
Number	0	6	0	0	0	0	0	0	0
Per cent	0.0	tr.	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Total	11,270	22,076	14,654	2,698	4,696	4,399	1,728	3,699	1,957

* *Urophycis* sp.

creased markedly in 1960 as a result of recruitment from the 1958 year class (Briggs, 1962). They remained high in this area from 1961 through 1963, although they declined somewhat in 1963. On the other hand, the catch on Fire Island increased markedly in 1963, while between Moriches Inlet and Shinnecock Inlet fewer were taken.

Catches of bluefish fluctuated, with the greatest numbers being taken in 1962. Bluefish generally comprised a greater proportion of the sport catch in the surf between Moriches Inlet and Shinnecock Inlet than in the areas west of Moriches Inlet.

Summer flounder (*Paralicthys dentatus*) and winter flounder (*Pseudopleuronectes americanus*) were the only other species that exceeded 3 per cent of the surf catch in any area in any year. The summer flounder seemed to be of greater importance between Moriches Inlet and Shinnecock Inlet than in the other areas.

The species composition of the catch of surf anglers at night between Jones Inlet and Fire Island Inlet differed from that of their daytime counterparts (Table 5). The night catch was dominated by only two species,

Table 5. Species Composition (in per cent) of the Surf Catch at Night from Jones Inlet to Fire Island

Species	1962	1963
Striped bass	62.9	50.4
Bluefish	25.7	44.0
Northern puffer	6.5	3.6
Northern kingfish	3.5	1.0
Winter flounder	0.5	0.4
Summer flounder	0.5	0.3
Weakfish	0.4	0.3
Total	100.0	100.0

striped bass and bluefish. Northern puffer and northern kingfish contributed less to the catch at night than they did during the day. The number of species taken was less than during the day. The greater use of artificial lures rather than bait was probably one of the reasons for the smaller percentage of northern puffer and the fewer species in the catch. Also, the northern puffer did not appear to be as active at night as during the day.

JONES INLET TO FIRE ISLAND INLET

In April and November, striped bass were sought by all the surf anglers between Jones Inlet and Fire Island Inlet, and in May and October by nearly all (Table 6). Only in July and August of 1961 did less than two-thirds of the anglers seek this species. Although large

numbers of anglers sought striped bass during the summer, the catch per effort was extremely low. Striped bass catches and catch per effort were highest in the spring (April and May) and fall (September, October and November), coinciding with the migratory patterns of this fish. Only at those periods and in July of 1961 did the catch exceed 0.1 fish per angler per trip. Even during the spring and fall the anglers rarely exceeded 0.5 fish per trip. Except in 1961, the spring peaks in catch and catch per effort exceeded those for the fall.

Northern kingfish were important in this area from June through September (Table 6). None were taken, nor were they sought by the surf anglers, in April and November. During the summer of 1961, it was the most frequently taken species. In July and August of that year, nearly two-thirds of the surf anglers sought them. Catch per effort was high in 1961, generally about 1.0 fish per angler per trip. After 1961, there was a decline in all aspects of the surf fishery for kingfish. Catch, catch per effort, the proportion of the total catch each month, the number of anglers seeking them, and the proportion of the total anglers each month who fished for kingfish all declined. Even with the decline, catch per effort for kingfish remained generally higher than for other species sought by surf anglers in this area. Briggs (1962) reported that the catch per effort for northern kingfish remained high from 1957 through 1960 and that the catch and the numbers of anglers that sought them showed a steady increase.

Bluefish were generally taken from May through September in this area (Table 6). The catch and catch per effort fluctuated greatly from year to year. In May, for example, none were taken in 1961, while 1,130 were taken in 1962 and only 59 in 1963. Fluctuations were also evident for the period of June through September, especially in 1962. Fluctuations of this sort were also noted for the years 1956 through 1960 by Briggs (1962). Except when great numbers were taken, the catch and catch per effort were generally only slightly greater than those for striped bass. However, in May and September of 1962, when large numbers were caught, catch per effort exceeded that for all other species taken in the surf. More anglers seemed to be attracted to seeking bluefish when the catch per effort was high.

At night, greater percentages of the surf anglers between Jones Inlet and Fire Island Inlet sought striped bass and bluefish than during the day (Table 7). Kingfish were rarely sought by the night anglers. Catches per effort for all fish sought were generally higher at night. This was particularly noticeable for striped bass in April and November and for bluefish throughout the year. Further indication of greater catches per effort at night was shown by the shorter average length of fishing trips at that time. Night anglers between Jones Inlet and Fire Island Inlet averaged 2.2 hours per trip in 1962 and 2.1 hours per trip

Table 6. Catch of Striped Bass, Northern Kingfish and Bluefish by Surf Anglers from Jones Inlet to Fire Island Inlet

Item	April	May	June	July	Aug.	Sept.	Oct.	Nov.
Striped bass								
1961								
Catch								
Number	91	611	91	266	100	1,713	665	774
Per cent of total*	93.3	49.0	10.0	8.8	7.0	63.0	62.7	99.0
Catch per effort§	0.2	0.5	0.1	0.2	0.1	1.0	0.6	0.7
Anglers								
Number	490	1,373	1,117	1,675	1,089	1,733	1,163	1,115
Per cent of total*	100.0	99.0	73.9	49.7	45.9	76.5	98.6	100.0
1962								
Catch								
Number	2,255	1,111	41	225	74	740	181	147
Per cent of total*	98.3	17.3	1.8	7.2	3.7	14.2	87.5	85.2
Catch per effort§	1.5	0.4	tr.	0.1	0.1	0.3	0.1	0.1
Anglers								
Number	1,530	3,084	1,392	2,030	1,281	2,321	1,030	860
Per cent of total*	100.0	91.4	68.4	78.2	70.7	80.3	99.3	100.0
1963								
Catch								
Number	945	1,229	246	226	467	384	239	257
Per cent of total*	85.1	27.1	5.6	11.5	32.2	61.4	90.5	88.5
Catch per effort§	0.4	0.4	0.1	0.1	0.1	0.2	0.2	0.3
Anglers								
Number	2,220	3,013	2,416	2,141	3,479	2,049	1,318	969
Per cent of total*	100.0	99.7	92.9	87.0	95.9	98.3	100.0	100.0
Northern kingfish								
1961								
Catch								
Number	0	130	522	2,254	906	600	132	0
Per cent of total*	0.0	10.4	57.5	74.3	63.7	22.1	12.4	0.0
Catch per effort§	....	1.0	1.0	1.1	0.6	0.9	1.3	....
Anglers								
Number	0	135	559	2,062	1,486	686	101	0
Per cent of total*	0.0	9.7	36.9	61.2	62.6	30.3	8.6	0.0
1962								
Catch								
Number	0	129	750	675	450	852	17	0
Per cent of total*	0.0	2.0	33.5	21.7	22.6	16.4	8.4	0.0
Catch per effort§	....	0.3	0.7	0.7	0.7	1.2	0.4	....
Anglers								
Number	0	363	1,057	964	705	694	35	0
Per cent of total*	0.0	10.8	52.0	37.1	38.9	24.0	3.4	0.0

TABLE 6. (*concluded*)

Item	April	May	June	July	Aug.	Sept.	Oct.	Nov.
				1963				
Catch								
Number	0	108	307	289	335	44	25	0
Per cent of total*	0.0	2.4	6.9	14.7	23.1	7.0	9.5	0.0
Catch per effort§	....	0.6	0.6	0.5	0.6	0.2	0.7	....
Anglers								
Number	0	134	500	511	545	230	34	0
Per cent of total*	0.0	4.4	19.2	20.8	15.0	11.1	2.6	0.0
				Bluefish				
				1961				
Catch								
Number	0	0	91	154	64	194	11	0
Per cent of total*	0.0	0.0	10.0	5.1	4.5	7.1	1.0	0.0
Catch per effort§	....	....	0.3	0.2	0.1	0.4	0.7	....
Anglers								
Number	0	0	349	1,015	743	549	16	0
Per cent of total*	0.0	0.0	23.1	30.1	31.3	24.2	1.2	0.0
				1962				
Catch								
Number	0	1,130	27	135	64	3,565	0	0
Per cent of total*	0.0	17.6	1.2	4.3	3.2	68.5	0.0	0.0
Catch per effort§	....	1.6	0.1	0.1	0.1	2.9	0.0	....
Anglers								
Number	0	708	254	1,196	468	1,263	14	0
Per cent of total*	0.0	21.0	12.5	46.1	25.6	43.7	1.4	0.0
				1963				
Catch								
Number	0	59	338	245	270	187	0	0
Per cent of total*	0.0	1.3	7.6	12.5	18.6	29.8	0.0	0.0
Catch per effort§	....	0.4	0.6	0.3	0.2	0.4	0.0	....
Anglers								
Number	0	162	561	776	1,603	558	23	0
Per cent of total*	0.0	5.4	21.6	31.5	44.2	26.7	1.7	0.0

* Based on total catch of all species or on all anglers fishing in the surf each month.

§ Catch per effort may not exactly equal the ratio of catch to anglers in the figures given because the values for catch per effort were derived directly from the interview records, whereas those for number of anglers and number of fish caught were calculated by incorporating data from the aerial censuses. Also, particularly with respect to kingfish, some fish were caught by anglers who were not seeking them and are included in the catch.

in 1963, while day trips in this area averaged 4.8 hours in 1962 and 4.7 hours in 1963.

Table 7. Proportion (in per cent)* of Surf Anglers at Night Who Sought Various Species, and Their Catch per Effort, from Jones Inlet to Fire Island Inlet

Species	April	May	June	July	Aug.	Sept.	Oct.	Nov.
				1962				
Striped bass								
Anglers	100.0	80.6	100.0	92.6	70.5	97.4	98.8	100.0
Catch per effort	1.8	0.6	0.2	0.3	0.1	0.3	0.1	0.7
Bluefish								
Anglers	0.0	28.8	12.1	18.5	42.9	10.9	8.6	0.0
Catch per effort	....	1.2	0.1	0.7	0.8	0.7	0.4	....
Northern kingfish								
Anglers	0.0	0.0	0.0	1.6	0.0	0.9	2.5	0.0
Catch per effort	....	....	....	0.3	....	3.0	1.3	....
				1963				
Striped bass								
Anglers	100.0	95.1	89.7	92.3	87.9	75.0	100.0	100.0
Catch per effort	0.7	0.3	0.1	0.1	0.1	0.3	0.3	0.8
Bluefish								
Anglers	0.0	17.2	20.1	22.1	28.5	42.8	4.6	0.0
Catch per effort	....	0.8	0.4	1.4	2.5	0.5	0.4	....
Northern kingfish								
Anglers	0.0	0.0	2.1	2.4	0.4	0.0	0.0	0.0
Catch per effort	....	....	1.0	0.5	0.0	....	....	....

* Combined percentages for most months exceed 100 because anglers usually sought more than one species on the same trip.

FIRE ISLAND

On Fire Island, as in the area between Jones Inlet and Fire Island Inlet, most of the surf anglers sought striped bass (Table 8); in fact, the proportion was even greater, being less than 70 per cent only in July, August and September of 1961. In 1963, only in June did less than 90 per cent of the anglers seek striped bass. Catch per effort was generally higher on Fire Island than on the barrier beach to the west. Spring and fall peaks in catch per effort were also evident on Fire Island.

Northern kingfish were not as important on Fire Island as they were between Jones Inlet and Fire Island Inlet (Table 8) although the catch per effort was somewhat higher. However, the number of anglers seeking kingfish, as well as their total catch and catch per effort, declined in 1962 and 1963.

Bluefish appeared later in the catches on Fire Island than in those between Jones Inlet and Fire Island Inlet (Table 8). Only in 1962

TABLE 8. CATCH OF STRIPED BASS, NORTHERN KINGFISH AND BLUEFISH BY SURF ANGLERS ON FIRE ISLAND

Item	April	May	June	July	Aug.	Sept.	Oct.	Nov.
Striped bass								
1961								
Catch								
Number	0	48	20	74	56	93	126	164
Per cent of total*	0.0	100.0	26.8	11.5	6.3	14.3	58.0	100.0
Catch per effort§	0.0	0.3	0.1	0.2	0.1	0.3	0.6	0.8
Anglers								
Number	40	161	160	364	446	340	227	205
Per cent of total*	100.0	100.0	86.1	67.4	54.5	57.7	94.3	100.0
1962								
Catch								
Number	31	101	21	109	65	151	173	42
Per cent of total*	98.3	14.4	3.4	9.4	6.7	17.4	58.5	100.0
Catch per effort§	0.6	0.3	0.1	0.2	0.2	0.3	0.5	0.3
Anglers								
Number	54	336	265	556	400	601	364	140
Per cent of total*	100.0	95.6	83.6	71.5	78.0	82.9	98.5	100.0
1963								
Catch								
Number	69	388	91	237	155	310	350	490
Per cent of total*	66.7	35.2	16.4	36.0	25.7	61.5	92.5	100.0
Catch per effort§	0.2	0.8	0.2	0.3	0.2	0.5	0.9	1.6
Anglers								
Number	346	494	394	706	716	630	379	306
Per cent of total*	100.0	98.5	85.7	95.7	94.5	100.0	100.0	100.0
Northern kingfish								
1961								
Catch								
Number	0	0	14	307	618	406	24	0
Per cent of total*	0.0	0.0	19.5	47.5	68.8	62.5	11.1	0.0
Catch per effort§	....	....	1.1	1.8	1.7	1.3	1.1	....
Anglers								
Number	0	0	12	166	371	295	22	0
Per cent of total*	0.0	0.0	6.5	30.8	45.5	50.0	9.2	0.0
1962								
Catch								
Number	0	27	10	133	56	133	45	0
Per cent of total*	0.0	3.9	1.7	11.4	5.8	15.3	15.1	0.0
Catch per effort§	....	0.9	1.0	0.6	0.5	0.8	1.6	....
Anglers								
Number	0	31	10	207	116	117	34	0
Per cent of total*	0.0	8.8	3.3	26.7	22.5	24.4	10.1	0.0

Table 8. (*concluded*)

Item	April	May	June	July	Aug.	Sept.	Oct.	Nov.
				1963				
Catch								
Number	0	42	68	97	59	0	0	0
Per cent of total*	0.0	3.8	12.3	14.7	9.7	0.0	0.0	0.0
Catch per effort§	....	0.7	1.0	1.0	0.8	....	....	....
Anglers								
Number	0	57	66	96	74	0	0	0
Per cent of total*	0.0	11.4	14.3	13.0	9.7	0.0	0.0	0.0
			Bluefish					
				1961				
Catch								
Number	0	0	20	175	75	116	0	0
Per cent of total*	0.0	0.0	26.8	27.0	8.3	17.9	0.0	0.0
Catch per effort§	....	....	0.2	0.4	0.2	0.4	....	....
Anglers								
Number	0	0	112	420	464	306	0	0
Per cent of total*	0.0	0.0	60.2	77.9	56.8	51.9	0.0	0.0
				1962				
Catch								
Number	0	12	36	246	48	275	61	0
Per cent of total*	0.0	1.7	6.0	21.1	4.9	31.6	20.8	0.0
Catch per effort§	....	0.2	0.2	0.4	0.2	0.7	0.3	....
Anglers								
Number	0	58	218	646	265	407	224	0
Per cent of total*	0.0	16.5	68.9	83.0	51.6	56.1	60.6	0.0
				1963				
Catch								
Number	0	0	38	106	59	194	29	0
Per cent of total*	0.0	0.0	6.9	16.0	9.7	38.5	7.6	0.0
Catch per effort§	....	....	0.2	0.2	0.1	0.4	0.6	....
Anglers								
Number	0	0	190	476	590	424	51	0
Per cent of total*	0.0	0.0	41.3	64.6	77.9	67.3	13.5	0.0

* Based on total catch of all species or on all anglers fishing in the surf each month.

§ Catch per effort may not exactly equal the ratio of catch to anglers in the figures given because the values for catch per effort were derived directly from the interview records, whereas those for number of anglers and number of fish caught were calculated by incorporating data from the aerial censuses. Also, particularly with respect to kingfish, some fish were caught by anglers who were not seeking them and are included in the catch.

were bluefish caught on Fire Island in May. June catches were low in all three years. Catch and catch per effort showed fluctuations similar

to, but not as great as, those observed between Jones Inlet and Fire Island Inlet. Catch per effort was intermediate between those for striped bass and northern kingfish. A consistently greater proportion of the surf anglers on Fire Island sought bluefish than was the case between Jones Inlet and the Fire Island Inlet.

MORICHES INLET TO SHINNECOCK INLET

Despite anglers seeking them in this area, no striped bass were caught in April (Table 9). The peak catch during spring occurred in May. Except for 1961, all anglers there in April, May, October and November sought striped bass, whereas in the other areas there was usually a small proportion in May and October each year that did not seek this species. Catch per effort between Moriches Inlet and Shinnecock Inlet was close to that found on Fire Island. Both on Fire Island and in this area the peak catches per effort in the fall were greater than those in the spring. This was, except for 1961, the reverse of that found between Jones Inlet and Fire Island Inlet.

The northern kingfish was of little importance between Moriches Inlet and Shinnecock Inlet. Only in May, July and August of 1961 and July of 1962 did they exceed 8 per cent of the catch of all fish. Catch per effort for the few anglers that sought them was variable.

Catch and catch per effort for bluefish between Moriches Inlet and Shinnecock Inlet fluctuated erratically as in the other areas (Table 9). During June, July and August, most of the anglers sought bluefish. In each year, the bluefish catch in June was more than half that for all species combined. They were taken in May only once, in 1963; however, the catch per effort at that time (3.0) was the highest recorded for any species in the surf during this study.

DISCUSSION

The surf fishery in the area from Jones Inlet to Shinnecock Inlet expanded from 18,811 anglers in 1961 to 25,177 in 1963. The increased abaundance of striped bass, the introduction, wider use and simplicity of light tackle (spinning reels and fiber glass rods), and the wide publicity given outstanding surf catches by fishing and hunting columnists appear to have been the major factors. Other factors, such as population growth, rising salaries and increased leisure time may have also contributed. As this trend continues, access to the beaches will become more of a problem. There is need for greater access to Fire Island in the spring and fall when fishing for striped bass is most productive, if fishermen are to take full advantage of these runs. There is need for more public fishing areas between Moriches Inlet and Shinnecock Inlet and appropriate access to them. Acquisition of access rights by state or local agencies is a possibility to be explored.

Table 9. Catch of Striped Bass and Bluefish by Surf Anglers from Moriches Inlet to Shinnecock Inlet

Item	April	May	June	July	Aug.	Sept.	Oct.	Nov.
Striped bass								
1961								
Catch								
Number	0	145	20	82	38	67	121	55
Per cent of total*	0.0	36.3	20.6	19.2	12.5	20.8	100.0	100.0
Catch per effort§	0.0	0.4	0.2	0.2	0.2	0.3	0.6	0.5
Anglers								
Number	140	388	145	422	246	225	201	110
Per cent of total*	100.0	97.4	73.0	69.2	56.9	90.0	100.0	100.0
1962								
Catch								
Number	0	192	62	67	178	231	45	185
Per cent of total*	0.0	47.8	11.7	7.5	15.9	52.5	60.0	73.9
Catch per effort§	0.0	0.6	0.2	0.1	0.3	0.6	0.2	0.8
Anglers								
Number	108	334	294	514	580	403	187	250
Per cent of total*	100.0	100.0	66.0	75.4	82.6	91.6	100.0	100.0
1963								
Catch								
Number	0	93	125	113	129	89	152	97
Per cent of total*	0.0	40.9	27.3	26.1	28.8	75.0	94.7	100.0
Catch per effort§	0.0	0.5	0.3	0.2	0.2	0.3	0.8	0.4
Anglers								
Number	128	175	461	520	514	356	201	243
Per cent of total*	100.0	100.0	90.5	95.5	91.7	90.0	100.0	100.0
Bluefish								
1961								
Catch								
Number	0	0	67	213	76	25	0	0
Per cent of total*	0.0	0.0	67.6	50.0	25.0	7.6	0.0	0.0
Catch per effort§	....	....	0.6	0.4	0.2	0.3	....	....
Anglers								
Number	0	0	119	500	333	88	0	0
Per cent of total*	0.0	0.0	60.3	82.1	76.9	35.0	0.0	0.0
1962								
Catch								
Number	0	0	435	95	51	204	20	0
Per cent of total*	0.0	0.0	81.7	10.8	4.6	46.3	26.7	0.0
Catch per effort§	....	....	1.3	0.2	0.2	0.6	0.3	....
Anglers								
Number	0	0	370	465	219	329	65	0
Per cent of total*	0.0	0.0	83.0	68.1	31.2	74.7	35.0	0.0
1963								
Catch								
Number	0	124	242	90	123	30	8	0
Per cent of total*	0.0	54.6	52.7	20.7	27.4	25.0	5.3	0.0
Catch per effort§	....	3.0	0.5	0.2	0.3	0.1	0.3	....
Anglers								
Number	0	41	461	377	456	247	25	0
Per cent of total*	0.0	23.5	90.5	69.4	81.3	62.5	12.5	0.0

* Based on total catch of all species or on all anglers fishing in the surf each month.

§ Catch per effort may not exactly equal the ratio of catch to anglers in the figures given because the values for catch per effort were derived directly from the interview records, whereas those for number of anglers and number of fish caught were calculated by incorporating data from the aerial censuses.

Increased use of artificial lures in May, June and July (particularly between Jones Inlet and Fire Island Inlet) would reduce the numbers of the undesired northern puffer in the catches. For the angler who prefers to use bait, fishing at night would reduce puffer catches.

The catchability of striped bass and bluefish appears to be better at night than during the day. This was indicated by the generally higher catches per effort, the shorter time of the average fishing trip, and the possibly greater number of anglers fishing at night. Therefore, if the surf angler wants the greatest return for his efforts for striped bass and bluefish, he should fish at night. If the surf angler prefers to fish during the day, he would probably get the best fishing for these species east of Fire Island Inlet.

Despite poor catch per effort, a large proportion of the anglers fished for striped bass in the summer. These anglers would do better to fish during the spring or fall migrations of this fish when the degree of success is higher.

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THE SPORT FISHERIES FOR WINTER FLOUNDER IN SEVERAL BAYS OF LONG ISLAND[1]

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ABSTRACT

The sport fisheries for winter flounder in Great South Bay, Moriches Bay, Shinnecock Bay, and Gardiners Bay and the Peconic Bays were studied from 1961 through 1963. An average of 193,482 anglers landed an average of 2,665,619 winter flounder each year. Great South Bay attracted the most winter flounder anglers and more winter flounder were caught there than in any of the other bays. In all the bays, the catch, the number of anglers seeking this species and their catch per effort were highest in the spring. There was an indication that recent increases in the abundance of northern puffer resulted in lower-than-usual catches of winter flounder in Great South Bay in the spring. Poor fishing for summer flounder from 1961 through 1963 resulted in extension of winter flounder fishing in the south-shore bays through the summer. Similarly, poor fishing for scup in Gardiners Bay and the Peconic Bays in June 1963 resulted in increased effort for and catches of winter flounder. Large (305 millimeters or more in total length) winter flounder were present in numbers in the catches in the south-shore bays only during spring and fall. There was a consistently greater proportion of these large fish in the catch in Gardiners Bay and the Peconic Bays than in the other waters. Length-weight data revealed that females of given sizes generally outweighed males and that winter flounder were in their poorest condition in the spring when fishing effort and the catch were greatest. Females almost always outnumbered males in the sport catch and the proportion of females tended to become even greater in late fall. It is concluded that the anticipated increase in fishing pressure for this species would be best directed toward expansion of the fall fishery in all the bays and toward increased fishing at all seasons in Gardiners Bay and the Peconic Bays.

The sport fisheries for winter flounder (*Pseudopleuronectes americanus*) in Great South Bay, Moriches Bay, Shinnecock Bay, and Gardiners Bay and the Peconic Bays were studied during the spring (March through June) and fall (October through December) from 1961 through 1963. The purpose was to determine the winter flounder catch, the number of anglers involved and their degree of success, and the size and sex of the fish taken. Additional data on catch per effort and the proportion of all anglers that were seeking winter flounder were collected during the summers. Great South Bay, Moriches Bay and Shinnecock Bay are located on the south shore of Long Island (Figure 1). Gardiners Bay and the Peconic Bays join to form the body of water encompassed by the northern and southern forks of the eastern end of Long Island.

The south-shore bays are relatively shallow, lagoon type bays separated from the Atlantic Ocean by barrier beaches, and their inlets from the ocean are relatively narrow. Of the three, Moriches Bay is the shallowest, most of its area being shoal water 6 feet or less in depth. The western portions of Great South Bay and Shinnecock Bay are similar in depth to Moriches Bay, while the eastern portions average 10 feet deep.

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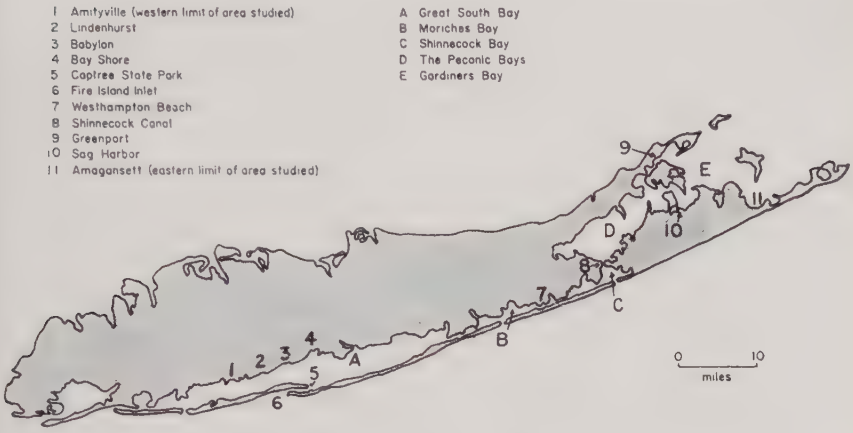

Figure 1. Map of Long Island showing bays and other features of the area studied.

Gardiners Bay and the Peconic Bays comprise a wide-mouth estuary which opens into the Atlantic Ocean. These bays are larger and deeper than the south-shore bays. Gardiners Bay averages about 30 feet in depth. The Peconics are, in general, only slightly shallower. The waters between the northwest shore of Shelter Island and the north fork of Long Island are the deepest in the area, ranging from 40 to 95 feet in depth.

METHODS

The data from personal interviews with 35,824 anglers, collected from March through December from 1961 through 1963 were used to determine the catch per effort (fish per angler per trip) for winter flounder, the proportion of all anglers seeking this species, the proportion of winter flounder in the total catch of all species, and the number of anglers per boat for the boat fisheries. Anglers who fished less than 4 hours were not recorded as this was considered to be the minimum for an angler trip. Although interviews were not originally scheduled during the summer, poor fishing for summer flounder (*Paralichthys dentatus*) in the south-shore bays necessitated continuing them in order to determine the proportion of the anglers that sought winter flounder at that time and their catch per effort.

Aerial censuses were flown during what were arbitrarily decided to be the normal periods of activity of winter flounder fishermen. These flights, randomly distributed throughout each season on weekdays and weekend days (holidays were considered as weekend days), were made from April through June and from October through November in 1961, and from March through June and from October through November in 1962 and 1963. There were 20 flights in 1961 and 23 each in 1962

and 1963. Aerial observation provided instantaneous total counts of the bank and pier anglers and of the boats involved in the various boat fisheries. These data were expanded by the method described by Briggs (1962) to determine the total number of anglers fishing for winter flounder and the total catch.

In addition to collecting data on the number of anglers involved, their catch per effort and total catch, 17,436 sport-caught winter flounder were measured for total length to the nearest 5 millimeters and weighed to the nearest 25 grams. Of these fish, 16,018 were sexed by external examination as described by Lux and Porter (undated). These data were collected at rowboat stations and on open boats from March through June and from September through December from 1961 through 1963 in the south-shore bays and from March through May and in October and November from 1961 through 1963 in Gardiners Bay and the Peconic Bays.

FISHING FACILITIES AVAILABLE

Anglers used five types of facilities in seeking winter flounder: banks and piers, rowboats, open boats, charter boats and private boats. The

Table 1. Boat Facilities Available to Anglers in the Area Studied

Type	1961	1962	1963
Great South Bay			
Open boats	32	32	32
Charter boats	65	67	62
Rowboat stations*	19(447)	20(422)	17(365)
Moriches Bay			
Open boats	0	0	0
Charter boats	0	0	0
Rowboat stations*	9(430)	9(433)	9(433)
Shinnecock Bay			
Open boats	0	0	0
Charter boats	0	0	0
Rowboat stations*	10(272)	10(282)	9(266)
Gardiners Bay and Peconic Bays			
Open boats	3	4	5
Charter boats	15	15	16
Rowboat stations*	16(589)	14(552)	14(540)

* Figures in parenthesis represent number of rowboats in each case.

differences in the types of boat facilities were defined by Briggs (1962). Those available in the different bays from year to year are shown in Table 1. In Great South Bay there were concentrations of open boats and charter boats at Lindenhurst, Babylon, Bay Shore and Captree State Park. There were eight charter boats berthed at the Shinnecock Canal in 1961, nine in 1962 and twelve in 1963. However, these boats all operated offshore and were not involved in the winter flounder fishery in any of the bays. Most of the open boats and charter boats used by anglers in the Gardiners Bay-Peconic Bays area were berthed at or near Greenport. Bank and pier angling was limited in all the bays, but there were concentrations in the Fire Island Inlet area of Great South Bay, at Westhampton Beach in Moriches Bay, at the Shinnecock Canal in Shinnecock Bay, and at Sag Harbor in Gardiners Bay.

THE ANGLERS AND THEIR CATCH

The data compiled served to indicate the magnitude and distribution of the sport fishery for winter flounder as well as variations in fishing activity. They also provided estimates of the total catch and the catch per effort for the different bays.

Number of Anglers and Variations in Fishing Activity

An average of 193,482 anglers sought winter flounder in the spring and fall each year (Table 2). The average for Great South Bay exceeded that for the other bays combined. The number of anglers increased steadily from 1961 through 1963 in Moriches Bay and in Gardiners Bay and the Peconic Bays, while in Great South Bay and Shinnecock Bay it remained fairly steady with only minor fluctuations.

Rowboats were generally the most popular facility for anglers seeking winter flounder. In Great South Bay, however, the majority usually used open boats and charter boats in March and April and private boats during the rest of the year. But Lobell (1939) had found that rowboats were predominant in Great South Bay in 1938 when 39,666 anglers used them compared with an average of 8,740 for the 1961-1963 period. Over the same interval the number using open boats increased from 12,727 to 27,133. These changes continued a trend first reported by Briggs (1962). Lobell combined data from Moriches Bay and Shinnecock Bay. Comparison of his records for these bays with those of the present study showed an increase in rowboat anglers from 24,934 to 46,750. In Gardiners Bay and the Peconic Bays, the number of anglers fishing for winter flounder from rowboats in the spring increased from 3,301 to 9,683 over the same period. Lobell noted that winter flounder fishing ceased in that area about the middle of May and gave no figures on such fishing there in the fall. During the present study fishermen using open boats and charter boats in Gardiners Bay and the Peconic

Table 2. Estimated Number of Anglers Seeking Winter Flounder Each Month According to Facility Used

Area	March			April			May			June			Spring		
	1961*	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963
Bank and pier															
Great South Bay		1,034	4,922	4,385	6,904	4,773	4,681	5,304	3,471	3,980	3,047	1,425	13,046	16,289	14,591
Moriches Bay		320	1,714	1,260	2,351	1,599	1,425	1,339	1,006	300	329	403	2,985	4,339	4,722
Shinnecock Bay		442	1,127	850	1,238	688	575	1,041	512	330	217	357	1,755	2,938	2,684
Gardiners and Peconic Bays		20	450	360	840	641	319	109	654	643	556	480	1,322	1,525	2,225
Total		1,816	8,213	6,855	11,333	7,701	7,000	7,793	5,643	5,253	4,149	2,665	19,108	25,091	24,222
Rowboat															
Great South Bay		90	938	2,712	3,851	1,573	3,956	3,544	1,399	2,126	1,623	885	8,794	9,108	4,795
Moriches Bay		398	5,046	6,134	10,443	8,126	7,428	9,024	8,309	8,202	8,818	5,959	21,764	28,683	27,440
Shinnecock Bay		43	1,478	1,296	3,860	2,257	4,045	4,094	3,098	2,707	3,999	2,194	8,048	11,996	9,027
Gardiners and Peconic Bays		121	2,006	3,286	6,150	4,717	3,286	4,179	3,309	0	225	1,769	6,572	10,675	11,801
Total		652	9,468	13,428	24,304	16,673	18,715	20,841	16,115	13,035	14,665	10,807	45,178	60,462	53,063
Open boat															
Great South Bay		1,697	5,668	7,196	9,174	11,480	9,114	8,651	6,826	2,046	3,439	732	18,356	22,961	24,706
Gardiners and Peconic Bays		8	165	514	856	1,659	511	801	1,261	0	0	738	1,025	1,665	3,823
Total		1,705	5,833	7,710	10,030	13,139	9,625	9,452	8,087	2,046	3,439	1,470	19,381	24,626	28,529
Charter boat															
Great South Bay		1,080	2,853	9,547	4,439	3,528	3,050	10,561	4,104	944	2,640	3,864	13,541	18,720	14,349
Gardiners and Peconic Bays		§	220	326	963	1,600	337	996	1,852	0	0	685	663	1,959	4,357
Total		1,080	3,073	9,873	5,402	5,128	3,387	11,557	5,956	944	2,640	4,549	14,204	20,679	18,706
Private boat															
Great South Bay		161	1,375	6,589	5,927	4,863	10,767	6,786	7,290	5,992	7,515	2,386	23,348	20,389	15,914
Moriches Bay		27	185	1,192	1,151	1,033	1,859	2,402	1,441	1,443	1,870	759	4,494	5,450	3,418
Shinnecock Bay		8	153	1,140	690	445	555	763	876	238	291	377	1,933	1,752	1,851
Gardiners and Peconic Bays		33	578	2,384	2,417	2,402	1,306	1,533	2,033	79	99	146	3,769	4,082	5,159
Total		229	2,291	11,305	10,185	8,743	14,487	11,484	11,640	7,752	9,775	3,668	33,544	31,673	26,342

TABLE 2. (*continued*)

Area	March			April			May			June			Spring		
	1961*	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963
Total															
Great South Bay	....	4,062	15,756	30,429	30,295	26,217	31,568	34,846	23,090	15,088	18,264	9,292	77,085	87,467	74,355
Moriches Bay		745	6,945	8,586	13,945	10,758	10,712	12,765	10,756	9,945	11,017	7,121	29,243	38,472	35,580
Shinnecock Bay		493	2,758	3,286	5,788	3,390	5,175	5,898	4,486	3,275	4,507	2,928	11,736	16,686	13,562
Gardiners and Peconic Bays		182	3,419	6,870	11,226	11,019	5,759	7,618	9,109	722	880	3,818	13,351	19,905	27,365
Total	....	5,482	28,878	49,171	61,254	51,384	53,214	61,127	47,441	29,030	34,668	23,159	131,415	162,531	150,862

* * * * * * * * * *

	October			November			Fall			Total			
	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963	Average
Bank and pier													
Great South Bay	1,940	2,575	2,879	2,235	2,140	2,673	4,175	4,715	5,552	17,221	21,004	20,143	19,456
Moriches Bay	1,014	1,494	2,388	1,200	1,110	1,074	2,214	2,604	3,462	5,199	6,943	8,184	6,775
Shinnecock Bay	460	809	961	675	600	750	1,135	1,409	1,711	2,890	4,347	4,395	3,877
Gardiners and Peconic Bays	305	293	921	115	110	180	420	403	1,101	1,742	1,928	3,326	2,332
Total	3,719	5,171	7,149	4,225	3,960	4,677	7,944	9,131	82 11, 6	27,052	34,222	36,048	32,441
Rowboat													
Great South Bay	929	725	794	619	160	296	1,548	885	1,090	10,342	9,993	5,885	8,740
Moriches Bay	4,977	4,084	7,128	4,442	1,956	2,046	9,419	6,040	9,174	31,183	34,723	36,614	34,173
Shinnecock Bay	2,399	1,770	1,850	1,779	229	633	4,178	1,999	2,483	12,226	13,995	11,510	12,577
Gardiners and Peconic Bays	855	384	1,451	345	220	465	1,200	604	1,916	7,772	11,279	13,717	10,923
Total	9,160	6,963	11,223	7,185	2,565	3,440	16,345	9,528	14,663	61,523	69,990	67,726	66,413

Table 2. (*concluded*)

Area	October			November			Fall			Total			Average
	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963	
Open boat													
Great South Bay	2,637	2,774	4,317	1,435	1,776	2,438	4,072	4,550	6,755	22,428	27,511	31,461	27,133
Gardiners and Peconic Bays	178	96	117	240	0	65	418	96	182	1,443	1,761	4,005	2,403
Total	2,815	2,870	4,434	1,675	1,776	2,503	4,490	4,646	6,937	23,871	29,272	35,466	29,536
Charter boat													
Great South Bay	1,476	2,739	3,337	343	240	2,223	1,819	2,979	5,560	15,360	21,699	19,909	18,989
Gardiners and Peconic Bays	0	26	340	780	144	74	780	170	414	1,443	2,129	4,771	2,781
Total	1,476	2,765	3,677	1,123	384	2,297	2,599	3,149	5,974	16,803	23,828	24,680	21,770
Private boat													
Great South Bay	5,228	3,327	5,768	2,158	1,009	3,375	7,386	4,336	9,143	30,734	24,725	25,057	26,839
Moriches Bay	2,015	1,216	2,626	1,703	1,691	1,504	3,718	2,907	4,130	8,212	8,357	7,548	8,039
Shinnecock Bay	1,068	410	537	465	373	510	1,533	783	1,047	3,466	2,535	2,898	2,966
Gardiners and Peconic Bays	934	202	1,104	479	216	489	1,413	418	1,593	5,182	4,500	6,752	5,478
Total	9,245	5,155	10,035	4,805	3,289	5,878	14,050	8,444	15,913	47,594	40,117	42,255	43,322
Total													
Great South Bay	12,210	12,140	17,095	6,790	5,325	11,005	19,000	17,465	28,100	96,085	104,932	102,455	101,157
Moriches Bay	8,006	6,794	12,142	7,345	4,757	4,624	15,351	11,551	16,766	44,594	50,023	52,346	48,988
Shinnecock Bay	3,927	2,989	3,348	2,919	1,202	1,893	6,846	4,191	5,241	18,582	20,877	18,803	19,421
Gardiners and Peconic Bays	2,272	1,001	3,933	1,959	690	1,273	4,231	1,691	5,206	17,582	21,597	32,571	23,916
Total	26,415	22,924	36,518	19,013	11,974	18,795	45,428	34,898	55,313	176,843	197,429	206,175	193,482

* No aerial census made in March of 1961.
§ Charter boats not operating.

Bays concentrated their efforts in the fall on tautog (*Tautoga onitis*) and bluefish (*Pomatomus saltatrix*), and the number of anglers seeking winter flounder carried by these facilities was often low at this time. For example, no winter flounder anglers were carried by charter boats in October 1961 or by open boats in November 1962.

In all the bays, there were generally more anglers seeking winter flounder during each of the spring months than during either of the fall months. In Moriches Bay and in Gardiners Bay and the Peconic Bays such fishing was usually at its height during April, while in Great South Bay and Shinnecock Bay it was greatest during May.

Few winter flounder anglers were found in June of 1961 and 1962 in Gardiners Bay and the Peconic Bays. However, in June of 1963 there was a five-fold increase among rowboat anglers seeking winter flounder, and only in 1963 did open boat and charter boat anglers in these waters seek winter flounder in June. This tremendous increase in effort was apparently caused by poor fishing for scup (*Stenotomus chrysops*). A similar dependence on winter flounder was found by Briggs (1962) in Great South Bay when fishing for summer flounder was poor.

Comparison of the present data for Great South Bay with those from 1956 through 1960 (Briggs, 1962) revealed no great change in the number of winter flounder anglers in April. However, in May and June the average for the two months decreased from 63,799 to 44,049. This decline was apparently due to an increase in the abundance of northern puffer (*Sphaeroides maculatus*). In 1960, only 58,185 northern puffer were landed in Great South Bay from April through October. But during May and June alone 95,373 were landed in 1961, and the number increased to 313,765 in 1962 and remained high (244,589) in 1963. These fish were regarded as a nuisance by most anglers and were not actively sought. They appeared to take the bait more readily than the winter flounder, and many anglers complained of northern puffers "stealing" their bait. This appears to have discouraged many from trying to catch winter flounder. The increase in northern puffer was also the probable cause of the decline in winter flounder catch in Great South Bay from 1,861,509 in 1960 to an average of 1,336,829 for the years 1961 through 1963.

Nearly all the anglers in all the bays in March and April sought winter flounder (Table 3). In May, most of the anglers in the south-shore bays sought winter flounder, while in Gardiners Bay and the Peconic Bays the proportion was usually lower due to the entrance of scup into the boat fisheries and northern puffer into the bank and pier fishery. In June, in the south-shore bays, except for the rowboat fishery in Moriches Bay, the proportion declined sharply as the summer flounder became the preferred fish. From June through September in Gardiners Bay and the Peconic Bays, there was usually an insignificant amount of angling for

Table 3. Percentage of All Anglers That Were Seeking Winter Flounder Each Month According to Facility

Area	March			April			May			June			July		
	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963
Bank and pier															
Great South Bay	100.0	100.0	100.0	100.0	98.9	98.1	91.0	83.7	60.4	62.2	46.2	19.5	28.2	28.5	27.3
Moriches Bay	100.0	100.0	100.0	100.0	100.0	100.0	95.8	99.0	96.6	49.6	68.9	63.0	47.4	55.6	74.2
Shinnecock Bay	100.0	100.0	100.0	100.0	100.0	100.0	60.0	52.9	66.3	13.9	13.5	21.9	7.9	7.4	6.7
Gardiners and Peconic Bays	100.0	100.0	100.0	100.0	100.0	100.0	54.5	22.2	95.2	51.4	87.5	35.7	63.6	0.0	69.2
Rowboat															
Great South Bay	100.0	100.0	100.0	100.0	100.0	100.0	100.0	103.0	100.0	44.4	57.9	60.0	11.5	18.4	48.6
Moriches Bay	100.0	100.0	100.0	100.0	100.0	100.0	97.4	100.0	99.5	80.6	88.3	88.9	43.0	81.9	91.4
Shinnecock Bay	100.0	100.0	100.0	100.0	100.0	100.0	100.0	90.2	100.0	46.3	54.6	52.3	21.2	23.1	43.8
Gardiners and Peconic Bays	100.0	100.0	100.0	100.0	100.0	100.0	81.0	89.2	83.3	0.0	6.2	42.1	0.0	0.0	0.0
Open boat															
Great South Bay	100.0	100.0	100.0	100.0	100.0	100.0	97.2	97.8	100.0	11.6	44.4	10.0	0.0	19.1	15.2
Gardiners and Peconic Bays	*	100.0	100.0	100.0	100.0	100.0	40.0	79.6	71.2	0.0	0.0	82.6	0.0	0.0	0.0
Charter boat															
Great South Bay	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	25.0	50.4	44.2	0.0	0.0	14.7
Gardiners and Peconic Bays	*	*	100.0	100.0	100.0	100.0	40.0	65.0	100.0	0.0	0.0	40.7	0.0	0.0	0.0
Private boat															
Great South Bay	100.0	100.0	100.0	100.0	93.9	100.0	91.2	59.0	93.2	31.0	59.5	28.4	2.1	20.2	10.1
Moriches Bay	100.0	100.0	100.0	100.0	100.0	100.0	95.5	88.4	94.9	55.3	58.7	34.3	9.2	39.5	56.9
Shinnecock Bay	....	100.0	100.0	100.0	100.0	100.0	42.3	65.6	100.0	9.3	12.3	33.3	0.0	20.0	0.0
Gardiners and Peconic Bays	....	100.0	100.0	100.0	100.0	100.0	53.2	50.0	78.9	1.5	2.4	5.1	0.0	0.0	0.0

TABLE 3. (*concluded*)

Area	August			September			October			November			December		
	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963
Bank and pier															
Great South Bay	27 7	8 4	30 7	24 9	26 0	26 2	81 5	95 9	86 7	100 0	100 0	100 0	100 0	100 0	100 0
Moriches Bay	23 4	22 6	40 5	0 0	25 0	56 3	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0
Shinnecock Bay	5 3	8 8	7 5	22 4	15 7	24 5	88 9	96 4	92 6	100 0	100 0	97 7	100 0	100 0	100 0
Gardiners and Peconic Bays	52 6	6 7	9 1	35 3	22 2	61 3	100 0	100 0	100 0	100 0	100 0	100 0			....
Rowboat															
Great South Bay	39.8	33.3	70.0	52.9	35.6	70.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	*	*
Moriches Bay	61.5	38 5	65.4	74 2	56 8	71 2	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0	100 0
Shinnecock Bay	44.3	41 8	58 7	59.2	92.3	91.1	100.0	100.0	100.0	100.0	100.0	100.0	100.0	100.0	*
Gardiners and Peconic Bays	1.9	0.0	0.0	0.0	0.0	0.0	97.9	71.4	96.0	100.0	100.0	100.0	*	*	*
Open boat															
Great South Bay	47 6	12 8	0 0	31 4	64 7	25 0	100 0	100 0	100.0	100.0	100 0	100 0	100 0	100 0	100 0
Gardiners and Peconic Bays	0 0	0 0	0 0	0 0	0 0	0 0	76 5	45.0	15 6	100 0	0 0	28 6	*	*	*
Charter boat															
Great South Bay	33.8	0.0	0.0	0.0	48.3	....	100.0	100.0	100.0	71.4	100.0	100.0	100.0	100.0	*
Gardiners and Peconic Bays	0 0	0.0	0.0	0.0	0.0	0 0	0.0	6 9	25.0	100.0	60.0	25.8	*	*	*
Private boat															
Great South Bay	7.1	1.5	2.3	16.7	9.9	14.0	79.8	81.9	97.8	41.8	100.0	95.5	100.0	100.0	100.0
Moriches Bay	7.8	20 8	38.1	23.7	24.4	68.0	100.0	100.0	100.0	100.0	100 0	100 0	100.0	100 0	100.0
Shinnecock Bay	0 0	0 0	0.0	0.0	0.0	27.3	100.0	64.3	66.7	100.0	100.0	100.0	100 0	100 0	. . .
Gardiners and Peconic Bays	1.7	0.0	0.0	3.8	0.0	2.1	67.5	25.9	50.0	84.6	81.0	81 7	....	....	....

* Facility not operating.

winter flounder. The occasionally high percentages of anglers seeking winter flounder from July through September in the south-shore bays each year was the expected result of poor fishing for summer flounder in these waters from 1961 through 1963. In the fall, nearly all the anglers in the south-shore bays sought winter flounder, but in Gardiners Bay and the Peconic Bays the proportion was generally lower.

Sport fishing for winter flounder in December was restricted to the south-shore bays and was confined largely to the first two weeks when the weather was favorable. The facilities available to the anglers were limited. One rowboat station in Shinnecock Bay remained open during December in 1961 and 1962. Two rowboat stations in Moriches Bay stayed open in December each year. In Great South Bay, one rowboat station remained open in December of 1961. Most of the open boats and charter boats berthed on Great South Bay operated offshore for cod (*Gadus morhua*) at this time. After the second weekend, the few facilities that had been available stopped operations for the year, and winter flounder fishing was restricted to a few scattered bank and pier anglers.

The Catch

The anglers in the various bays landed an average of 2,665,619 winter flounder each year (Table 4). More were taken in Great South Bay than in the other bays. The catch in the south-shore bays was fairly stable and showed only minor fluctuations from year to year. However, there was a substantial increase from 1961 to 1963 in Gardiners Bay and the Peconic Bays.

In general, seasonal and yearly variations in the catch were related to the number of anglers seeking winter flounder. For example, except for March 1961, the total catch for each month of the spring exceeded that for any fall month. The greatest catch usually occurred in May in the south-shore bays and in April in Gardiners Bay and the Peconic Bays. Most winter flounder were caught by rowboat anglers, except in Great South Bay where the most fish were taken by open boat and charter boat anglers in the spring and by private boat anglers in the fall.

Comparison of the figures in Table 4 with records for 1938 (Lobell, 1939) shows that, except for rowboat fishing in Great South Bay (where 125,105 were landed in 1938), the fisheries in each bay harvested much greater numbers of winter flounder from 1961 through 1963. In 1938 in Gardiners Bay and the Peconic Bays, the catch from charter boats was 18,887, that from open boats was 8,641, and that from rowboats was 19,934. For Moriches Bay and Shinnecock Bay combined, the harvest from rowboats was 301,419 in 1938. Open boat anglers in Great South Bay landed 152,203 winter flounder in 1938.

TABLE 4. ESTIMATED SPORT CATCH OF WINTER FLOUNDER EACH MONTH ACCORDING TO FACILITY

Area	March			April			May			June			Spring		
	1961*	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963
Bank and pier															
Great South Bay	3,516	15,257	8,590	24,745	10,629	20,179	13,218	9,627	11,305	4,279	1,276	40,074	45,758	36,789	
Moriches Bay	2,144	10,452	5,040	13,843	4,637	8,870	6,154	2,659	761	2,526	833	14,671	24,667	18,581	
Shinnecock Bay	2,519	4,621	3,060	4,070	963	958	1,509	399	922	277	569	4,940	8,375	6,552	
Gardiners and Peconic Bays	120	2,745	1,376	3,948	897	1,321	381	1,147	1,553	1,153	575	4,250	5,602	5,364	
Total	8,299	33,075	18,066	46,606	17,126	31,328	21,262	13,832	14,541	8,235	3,253	63,935	84,402	67,286	
Rowboat															
Great South Bay	891	11,819	44,405	52,536	20,760	88,666	52,115	22,331	21,389	15,558	11,387	154,460	121,100	66,297	
Moriches Bay	3,781	79,228	112,873	173,191	125,952	149,940	149,160	150,496	159,166	108,208	156,991	421,979	434,340	512,667	
Shinnecock Bay	1,248	29,411	19,437	71,416	25,726	80,448	65,499	63,907	51,183	53,727	42,259	151,068	191,890	161,303	
Gardiners and Peconic Bays	2,081	33,092	35,821	79,900	42,929	46,814	31,904	55,418	0	1,234	22,018	82,635	115,119	153,457	
Total	8,001	153,550	212,536	377,043	215,367	365,868	298,678	292,152	231,738	178,727	232,655	810,142	862,449	893,724	
Open boat															
Great South Bay	15,738	80,484	143,922	177,066	146,942	191,596	146,547	145,622	24,161	60,892	6,048	359,679	400,243	379,096	
Gardiners and Peconic Bays	151	2,987	10,282	24,230	25,052	1,530	13,855	30,525	0	24	20,756	11,812	38,260	79,320	
Total	15,889	83,471	154,204	201,296	171,994	193,126	160,402	176,147	24,161	60,916	26,804	371,491	438,503	458,416	
Charter boat															
Great South Bay	20,412	36,514	164,212	111,406	35,512	67,370	182,900	56,910	9,666	41,486	84,710	241,248	356,204	213,646	
Gardiners and Peconic Bays	§	4,268	5,614	26,579	28,486	1,011	16,177	53,481	0	33	17,714	6,625	42,789	103,949	
Total	20,412	40,782	169,826	137,985	63,998	68,381	199,077	110,391	9,666	41,519	102,424	247,873	398,993	317,595	
Private boat															
Great South Bay	2,619	19,796	36,237	148,256	59,479	240,158	132,844	147,848	81,065	107,621	40,491	357,460	391,340	267,614	
Moriches Bay	286	2,976	17,528	24,506	14,255	40,898	38,164	31,060	28,359	33,767	23,128	86,785	96,723	71,419	
Shinnecock Bay	178	2,735	18,240	13,317	6,224	8,983	8,483	12,623	5,860	2,328	7,697	33,083	24,306	29,279	
Gardiners and Peconic Bays	599	8,258	22,974	53,418	31,712	16,521	18,704	35,226	2,448	1,045	1,886	41,943	73,766	77,082	
Total	3,682	33,765	94,979	239,497	111,670	306,560	198,195	226,757	117,732	144,761	73,202	519,271	586,135	445,394	

Table 4. (*continued*)

Area	March			April			May			June			Spring		
	1961*	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963
Total															
Great South Bay	....	43,176	163,870	397,366	514,009	273,322	607,969	527,624	382,338	147,586	229,836	143,912	1,152,921	1,314,645	963,442
Moriches Bay	....	6,211	92,656	135,441	211,540	144,844	199,708	193,478	184,215	188,286	144,501	180,952	523,435	555,730	602,667
Shinnecock Bay	....	3,945	36,767	40,737	88,803	32,913	90,389	75,491	76,929	57,965	56,332	50,525	189,091	224,571	197,134
Gardiners and Peconic Bays	....	2,951	51,350	76,067	188,075	129,076	67,197	81,021	175,797	4,001	3,489	62,949	147,265	275,536	419,172
Total	....	56,283	344,643	649,611	1,002,427	580,155	965,263	877,614	819,279	397,838	434,158	438,338	2,012,712	2,370,482	2,182,415

* * * * * * * * * *

	October			November			Fall			Total			Average
	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963	
Bank and pier													
Great South Bay	4,734	7,098	6,500	6,227	4,057	10,144	10,961	11,155	16,644	51,035	56,913	53,433	53,794
Moriches Bay	4,487	10,358	12,838	7,320	5,550	5,048	11,807	15,908	17,886	26,478	40,575	36,467	34,507
Shinnecock Bay	1,263	1,824	7,265	2,093	1,582	4,026	3,356	3,406	11,291	8,296	11,781	17,843	12,640
Gardiners and Peconic Bays	244	923	3,626	230	385	518	474	1,308	4,144	4,724	6,910	9,508	7,047
Total	10,728	20,203	30,229	15,870	11,574	19,736	26,598	31,777	49,965	90,533	116,179	117,251	107,988
Rowboat													
Great South Bay	8,533	3,271	8,556	2,501	1,168	4,190	11,034	4,439	12,746	165,494	125,539	79,043	123,359
Moriches Bay	83,741	72,887	60,199	75,483	21,432	31,921	159,224	94,319	92,120	581,203	528,659	604,787	571,550
Shinnecock Bay	39,211	23,146	25,047	20,989	3,687	17,531	60,200	26,833	42,578	211,268	218,723	203,881	211,291
Gardiners and Peconic Bays	7,909	2,578	17,717	2,287	2,376	3,682	10,196	4,954	21,399	92,831	120,073	174,856	129,253
Total	139,394	101,882	111,519	101,260	28,663	57,324	240,654	130,545	168,843	1,050,796	992,994	1,062,567	1,035,452

TABLE 4. (*concluded*)

Area	October			November			Fall			Total			Average
	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963	
Open boat													
Great South Bay	24,415	30,162	48,208	18,792	28,771	22,913	43,207	58,933	71,121	402,886	459,176	450,217	437,426
Gardiners and Peconic Bays	2,617	852	1,552	2,344	0	948	4,961	852	2,500	16,773	39,112	81,820	45,902
Total	27,032	31,014	49,760	21,136	28,771	23,861	48,168	59,785	73,621	419,659	498,288	532,037	483,328
Charter boat													
Great South Bay	26,568	40,193	27,694	4,942	3,528	8,892	31,510	43,721	36,586	272,758	399,925	259,232	307,638
Gardiners and Peconic Bays	0	407	2,433	7,619	576	1,062	7,619	983	3,495	14,244	43,772	107,444	55,153
Total	26,568	40,600	30,127	12,561	4,104	9,954	39,129	44,704	40,081	287,002	443,697	357,676	362,792
Private boat													
Great South Bay	40,143	36,062	68,560	28,838	13,623	40,197	68,981	49,685	108,757	426,441	441,025	376,371	414,612
Moriches Bay	37,163	13,828	35,444	27,078	20,794	24,669	64,241	34,622	60,113	151,026	131,345	131,532	137,968
Shinnecock Bay	21,147	6,407	8,055	6,510	5,008	7,963	27,657	11,415	16,018	60,740	35,721	45,297	47,253
Gardiners and Peconic Bays	9,912	1,501	12,046	4,343	2,277	5,811	14,255	3,778	17,857	56,198	77,544	94,939	76,227
Total	108,365	57,798	124,105	66,769	41,702	78,640	175,134	99,500	202,745	694,405	685,635	648,139	676,060
Total													
Great South Bay	104,393	116,786	159,518	61,300	51,147	86,336	165,693	167,933	245,854	1,318,614	1,482,578	1,209,296	1,336,829
Moriches Bay	125,391	97,073	108,481	109,881	47,776	61,638	235,272	144,849	170,119	758,707	700,579	772,786	744,024
Shinnecock Bay	61,621	31,377	40,367	29,592	10,277	29,520	91,213	41,654	69,887	280,304	266,225	267,021	271,183
Gardiners and Peconic Bays	20,682	6,261	37,374	16,823	5,614	12,021	37,505	11,875	49,395	184,770	287,411	468,567	313,583
Total	312,087	251,497	345,740	217,596	114,814	189,515	529,683	366,311	535,255	2,542,395	2,736,793	2,717,670	2,665,619

* No aerial censuses made in March of 1961.
§ Charter boats not operating.

Table 5. Catch Per Effort for Winter Flounder Each Month According to Facility

Area	March			April			May			June			July		
	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963
Bank and pier															
Great South Bay	2.7	3.4	3.1	1.9	3.6	2.2	4.3	2.5	2.8	3.2	1.4	0.9	4.6	1.5	1.2
Moriches Bay	7.6	6.7	6.1	4.0	5.9	2.9	6.3	4.6	2.7	2.5	7.7	2.1	5.3	2.8	1.2
Shinnecock Bay	6.1	5.7	4.1	3.6	3.3	1.4	1.7	1.5	0.8	2.8	1.1	1.6	1.3	1.2	0.3
Gardiners and Peconic Bays	2.9	6.0	6.1	3.8	4.7	1.4	4.2	3.5	1.8	2.4	2.1	1.2	0.6	*	1.1
Rowboat															
Great South Bay	8.6	9.9	12.6	16.3	13.6	13.2	22.4	14.7	16.0	10.0	9.6	12.9	5.3	4.4	14.8
Moriches Bay	11.3	9.5	15.7	18.4	16.6	15.5	20.2	16.5	18.1	19.4	12.2	26.4	6.9	10.0	20.9
Shinnecock Bay	41.4	30.0	19.9	15.0	18.5	11.4	19.9	16.0	20.7	19.0	13.4	19.3	8.3	1.0	9.5
Gardiners and Peconic Bays	39.4	17.2	16.5	10.9	13.0	9.1	12.3	7.6	16.8	*	5.5	12.4	*	*	*
Open boat															
Great South Bay	19.9	9.3	14.2	20.0	19.3	12.8	21.1	16.9	21.3	11.8	17.7	8.3	*	8.4	16.0
Gardiners and Peconic Bays	§	18.9	18.1	20.0	28.3	15.1	3.0	17.3	24.2	*	*	28.1	*	*	*
Charter boat															
Great South Bay	21.3	18.9	12.8	17.2	25.1	10.9	22.1	17.4	13.9	10.3	15.6	21.9	*	*	9.2
Gardiners and Peconic Bays	§	§	19.4	17.2	27.6	17.8	3.0	16.2	28.9	*	*	25.8	*	*	*
Private boat															
Great South Bay	17.7	16.3	14.4	5.5	25.0	12.3	22.3	19.6	20.3	13.5	14.3	17.0	8.7	7.1	12.0
Moriches Bay	9.0	10.6	16.1	14.7	21.3	13.8	22.0	15.7	21.6	19.7	18.1	30.5	10.3	15.5	23.9
Shinnecock Bay	....	22.0	17.9	16.0	19.3	14.0	16.2	11.1	14.4	24.4	8.0	20.5	*	2.7	*
Gardiners and Peconic Bays	....	17.9	14.3	12.6	22.1	13.2	12.4	12.2	17.3	31.0	10.7	13.0	*	*	*

TABLE 5. (*concluded*)

Area	August			September			October			November			December		
	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963	1961	1962	1963
Bank and pier															
Great South Bay	4.2	3.6	0.6	1.9	0.9	0.7	2.5	2.8	2.3	2.8	1.9	3.8	1.3	0.9	1.0
Moriches Bay	5.1	1.1	0.8	*	1.8	4.4	4.4	6.9	5.4	6.1	5.0	4.7	3.6	3.4	2.1
Shinnecock Bay	3.0	0.7	0.8	0.9	0.2	0.3	2.7	2.2	7.5	3.1	2.7	5.4	1.8	1.1	2.1
Gardiners and Peconic Bays	2.6	0.0	1.5	3.7	1.0	1.5	0.8	3.1	3.9	2.0	3.5	2.9	...		
Rowboat															
Great South Bay	9.0	5.3	4.3	7.6	4.4	5.4	9.2	4.5	10.7	4.0	7.3	14.2	4.0	§	§
Moriches Bay	13.2	2.5	6.6	6.2	10.2	6.0	16.8	17.8	8.5	17.0	11.0	15.6	9.8	9.7	19.6
Shinnecock Bay	7.8	4.9	6.7	9.7	10.7	10.0	16.4	13.1	13.5	11.8	16.1	22.7	21.3	15.6	§
Gardiners and Peconic Bays	5.5	*	*	*	*	*	9.3	6.3	12.3	6.6	10.8	7.9	§	§	§
Open boat															
Great South Bay	14.3	1.5	*	5.0	6.4	11.6	9.2	10.9	11.1	13.1	16.2	9.4	12.4	9.1	7.8
Gardiners and Peconic Bays	*	*	*	*	*	*	14.7	8.9	13.3	9.8	*	14.7	§	§	§
Charter boat															
Great South Bay	13.3	*	*	*	4.4	....	18.0	14.7	8.3	14.4	14.7	4.0	17.0	17.3	§
Gardiners and Peconic Bays	*	*	*	*	*	*	*	15.5	5.9	9.8	4.0	14.3	§	§	§
Private boat															
Great South Bay	13.8	4.0	9.5	9.3	7.7	8.1	7.6	10.9	11.9	13.4	13.5	11.9	6.1	13.3	7.7
Moriches Bay	13.5	2.3	7.6	2.1	5.5	10.0	18.4	11.3	13.5	15.9	12.3	16.4	10.1	13.3	12.3
Shinnecock Bay	*	*	*	*	*	7.7	19.8	15.7	15.0	14.0	13.4	15.6	7.6	11.5	....
Gardiners and Peconic Bays	7.0	*	*	4.5	*	16.0	10.6	7.4	10.9	9.1	10.2	11.9	....	..	...

* No effort expended by anglers interviewed.

§ Facility not operating.

Catch per Effort

Catch per effort for winter flounder was generally highest in the spring and lowest in the summer (Table 5). For the boat fisheries in all the bays it was generally about 16 to 20 fish per angler per trip in the spring, 10 or less in the summer, and about 12 to 16 in the fall. Rowboat anglers in Great South Bay generally had lower rates of success than other boat anglers in this bay. Exceptionally high catches per effort were recorded in March 1961, when rowboat anglers in Shinnecock Bay and in Gardiners Bay and the Peconic Bays took 41.4 and 39.4 winter flounder per trip, respectively. In the fall, rowboat and private boat anglers in Great South Bay and in Gardiners Bay and the Peconic Bays had generally poorer success than their counterparts in Moriches Bay and Shinnecock Bay. Open boat and charter boat anglers generally had the best catches compared with other boat fishermen in the bays in which both groups were present, although the differences were usually small. In general, bank and pier anglers in all the bays had the lowest catch per effort.

The catch per effort for winter flounder was generally higher during the 1961-1963 period than that recorded by Lobell (1939) for 1938. For example in May 1938, rowboat anglers in Great South Bay caught an average of only 4.3 per trip compared with the lowest rate of success for this month (14.7 in 1962) recorded during the present study. Anglers fishing from open boats in October 1938 in Great South Bay caught 7.8 per trip compared with 9.2 to 11.1 for the same month in 1961-1963. In Gardiners Bay and the Peconic Bays, open boat anglers landed 6.6 per trip in April 1938 compared with a low of 15.1 in 1963 for this month during the present survey. Fishing success in Great South Bay from 1961 through 1963 was about the same as that reported by Briggs (1962) from 1956 through 1960.

Characteristics of Fish Taken

In addition to information on the anglers and their catch as a whole, data were recorded on various characteristics of the fish taken. Those pertaining to length frequency, length-weight relationships and sex ratios summarized here.

Length Frequency

Length-frequency data (Figure 2) showed that in the south-shore bays winter flounder entered the sport fishery in numbers at about 200 millimeters in total length. The largest fish in these waters reach 445 millimeters in total length, but few over 350 millimeters were taken. In Gardiners Bay and the Peconic Bays, winter flounder entered the sport fishery in numbers at about 260 millimeters in total length and may range up to 540 millimeters, although few over 400 millimeters were

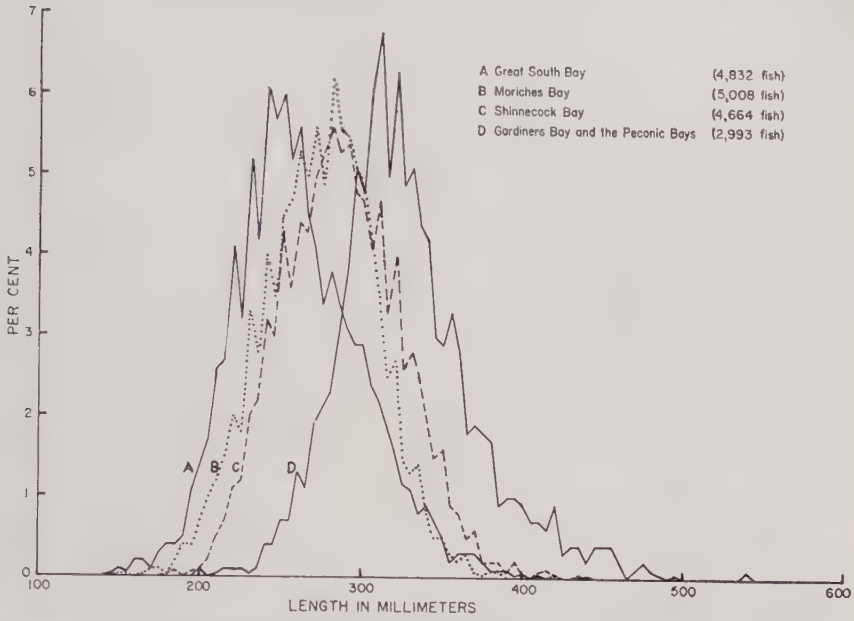

Figure 2. Length-frequency distribution, according to total length, of the sport-caught winter flounder (sexes combined) for the bays studied.

taken. There appears to have been a general trend toward larger fish in the eastern bays. Modal total length was lowest in Great South Bay (240 millimeters), intermediate in Moriches Bay and Shinnecock Bay (280 millimeters), and highest in Gardiners Bay and the Peconic Bays (310 millimeters). Lobell (1939) reported a similar concentration of larger fish in the Peconic Bays area. Modal total length of sport-caught winter flounder in April 1938 were 340 millimeters from the Peconic area, approximately 250 millimeters from Great South Bay and approximately 230 millimeters from Moriches Bay and Shinnecock Bay combined.

The distribution of large (305 millimeters in total length and larger) winter flounder from the sport catch in all the bays (Figure 3) showed both seasonal and area variations. Large fish comprised from 65 to 79 per cent of the monthly catch in Gardiners Bay and the Peconic Bays. These percentages were considerably higher than those recorded for comparable months in the south-shore bays where large fish were usually least frequent in Great South Bay and most frequent in Shinnecock Bay.

The presence of high proportions of large fish in the catch in the south-shore bays only in the spring and fall and the high catch per effort at these times corroborated the findings of Lobell (1939), Perlmutter (1947) and McCracken (1963) who reported seasonal movements of large winter flounder into the bays in the fall and out of the bays in late

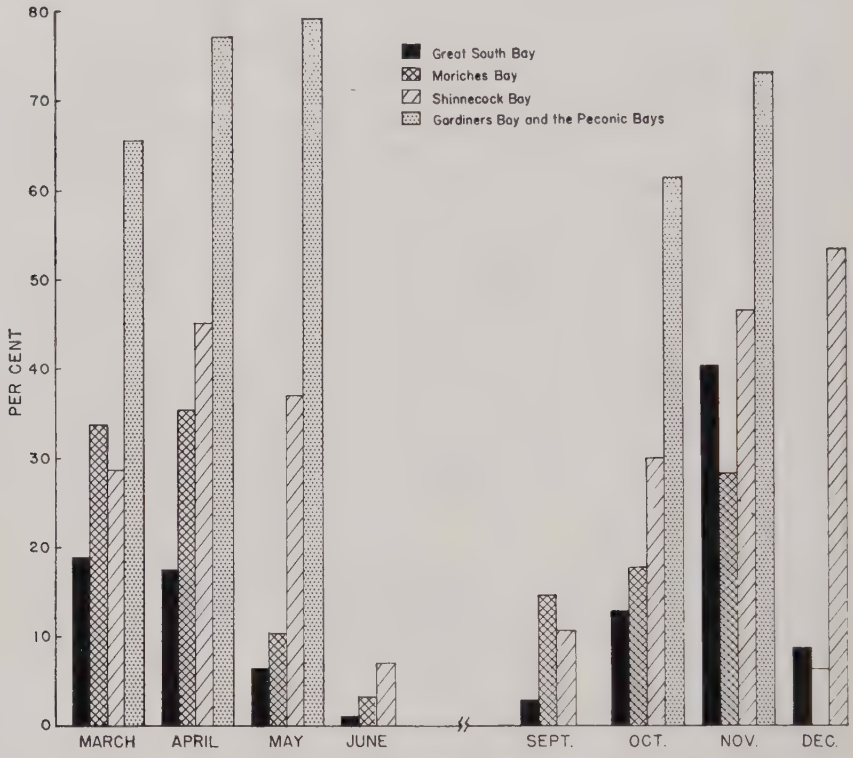

Figure 3. Proportion of large (305 or more millimeters in total length) winter flounder in the sport catch each month for the bays studied.

spring and early summer. In the spring there appeared to be an earlier movement of large fish from Great South Bay and Moriches Bay (April to May) than from Shinnecock Bay (May to June). In the fall the large fish appeared to return to Great South Bay and Moriches Bay later (October to November) than to Shinnecock Bay (September to October). The low proportion of large fish in the December catches from Great South Bay and Moriches Bay may have been related to the cessation of feeding by mature fish approaching spawning condition as suggested by Bigelow and Schroeder (1953).

Length-weight Relationships.

Length-weight relationships of both male and female winter flounder caught by sport fishermen in Great South Bay during the last month of each calendar quarter of the year were calculated (Table 6) for comparison with data reported by Lux and Porter (undated) for southern New England. The generally close (usually within 25 grams, except for fish 300 millimeters and over in total length) agreement of the calculated weights from these two widely separated areas (Table 7) indi-

TABLE 6. LENGTH-WEIGHT RELATIONSHIPS OF SPORT-CAUGHT WINTER FLOUNDER FROM GREAT SOUTH BAY

Item	Male	Female
	March	
Correlation	log W = 2.7511 log L − 4.3935	log W = 3.1533 log L − 5.3461
Length range*	210–380	180–400
Number of fish	171	442
	June	
Correlation	log W = 3.7876 log L − 6.8644	log W = 3.2210 log L − 5.4104
Length range*	205–325	150–340
Number of fish	67	302
	September	
Correlation	log W = 2.9582 log L − 4.8017	log W = 3.2782 log L − 5.5549
Length range*	180–350	175–320
Number of fish	84	273
	December	
Correlation	log W = 2.8554 log L − 4.5482	log W = 3.5763 log L − 6.2658
Length range*	165–365	150–375
Number of fish	36	371

* In millimeters.

cated a close correlation in length-weight relationships over a wide geographic range. Therefore, it may be assumed that either the present data or those of Lux and Porter will reasonably fit the length-weight relationship for winter flounder in the other bays studied.

For winter flounder of given lengths from Great South Bay calculated weights showed a rapid increase for females of all sizes and for males over 250 millimeters in total length from March through June. Smaller males showed a drop from March through June and then a rapid increase from June through September. Females showed a slight loss from June through September. Females over 250 millimeters in total length regained their lost weight (and often added more) by December (probably due to ripening of the ovaries), while smaller females (probably immature fish) continued to lose weight. Males 300 millimeters in total length and larger showed a loss from September through December, while smaller males continued to gain. Females 250 millimeters in total length and larger always weighed more than males of

Table 7. Calculated Weights* of Sport-caught Male and Female Winter Flounder from Great South Bay Compared with Data Calculated from Lux and Porter (undated)

Source of data and season	Sex	Total length§										
		150	175	200	225	250	275	300	325	350	375	400
Great South Bay (March)	Male	...	...	...	120	160	208	264	329	403	487	...
	Female	...	...	81	118	164	222	292	376	475	590	723
Lux and Porter (1st quarter)	Male	...	...	...	128	176	236	308	395	495	612	...
	Female	...	...	90	131	184	249	330	427	540	674	829
Great South Bay (June)	Male	...	...	...	111	165	237	330	446	...	...	...
	Female	40	65	100	145	206	280	370	479	...	...	...
Lux and Porter (2nd quarter)	Male	...	...	...	140	190	251	324	409	...	...	...
	Female	43	68	99	144	190	262	339	432	...	...	...
Great South Bay (September)	Male	...	...	101	143	196	260	336	426	530	...	...
	Female	...	63	97	143	202	277	368	...	...	...	...
Lux and Porter (3rd quarter)	Male	...	...	100	144	199	267	349	447	538	...	...
	Female	...	66	100	144	201	270	354	...	...	...	...
Great South Bay (December)	Male	...	72	105	147	199	277	335	421	520	...	...
	Female	33	57	92	140	204	287	392	522	680	870	...
Lux and Porter (4th quarter)	Male	...	61	94	137	193	261	346	447	567	...	...
	Female	41	66	99	143	199	267	350	449	564	699	...

* In grams.
§ In millimeters.

the same size. Peak weight for males under 300 millimeters in total length was reached in December. Peak weight for females 250 millimeters in total length was reached in June, while larger females reached peak weight in December.

Lux and Porter (undated) found that winter flounder of both sexes under 350 millimeters long increased in weight through the year to reach a peak in the third quarter (July-September) and then lost weight through the fourth quarter (October-December). They found that fish of both sexes over 350 millimeters long dropped in weight from the first quarter (January-March) to the second (April-June), reached a peak in the third quarter and then lost weight slightly in the fourth quarter. Although the present data did not always agree with those of Lux and Porter in regard to the time of peak condition, they did agree in the poorest condition occurring during the spring of the year when sport fishing for winter flounder was at its greatest intensity.

SEX RATIOS

The sex ratios of sport-caught winter flounder varied (Table 8), although they were generally close to the 70:30 female to male ratio reported by Saila (1961). Only once, for April of 1963 in Great South

TABLE 8. SEX RATIOS* OF SPORT-CAUGHT WINTER FLOUNDER

Area	Year	Spring				Fall			
		March	April	May	June	Sept.	Oct.	Nov.	Dec.
Great South Bay	1961	....	....	4.6	4.8	3.1	9.1	2.9	15.9
	1962	4.2	3.0	7.1	6.9	2.8	3.8	4.1	8.0
	1963	1.8	1.1	5.9	4.2	4.1	3.0	3.7	14.0
Moriches Bay	1961	....	2.8	3.5	2.9	4.6	2.9	2.6	22.1
	1962	2.6	3.1	4.3	1.5	3.6	3.4	6.3	12.6
	1963	2.5	1.8	2.0	1.3	....	3.6	5.3	13.1
Shinnecock Bay	1961	....	....	4.2	2.3	2.6	3.0	5.7	4.4
	1962	1.4	3.6	2.5	3.9	3.9	3.8	4.6	5.5
	1963	1.3	2.9	2.3	3.4	2.1	3.3	5.6	....
Gardiners and Peconic Bays	1961	....	....	3.4	....	....	5.3	7.4	....
	1962	2.7	4.1	2.4	....	....	2.3	5.1	....
	1963	4.1	2.5	2.4	....	....	2.4	6.0	....

* Females per male.

Bay, did chi-square tests fail to show a significant difference from a one to one ratio. In December of each year, the sex ratios in Great South Bay and Moriches Bay showed a significantly greater proportion of females than during the rest of each year. A similar change in sex

ratio was observed in Gardiners Bay and the Peconic Bays each November.

DISCUSSION

The winter flounder supports to a large extent the sport fisheries of Great South Bay, Moriches Bay, Shinnecock Bay and Gardiners Bay and the Peconic Bays. In addition to the usual spring and fall fishery, anglers turn to winter flounder in the summer when other fish (scup and summer flounder) are not readily available.

Except for the rowboat fishery in Great South Bay, which has declined, there has been a large increase in the catch of winter flounder and the number of anglers seeking them in all the bays since 1938. Catch per effort has similarly increased since 1938. The history of the sport fisheries for winter flounder in Long Island waters indicates that pressure on this fish will continue to increase. This pressure would be best directed toward expansion of the fall fishery in all the bays and toward increased fishing at all seasons in Gardiners Bay and the Peconic Bays.

Although catches and angling pressure are highest in the spring, winter flounder are in their poorest condition at that time. Summer fishing provides fish in good condition, but few of large size, and catch per effort is relatively low. Fall fishing provides fish of large size at or near peak weights. For these reasons and because catch per effort remains reasonably high in the fall, sport fishing for winter flounder at that season could well be expanded in all the bays.

Gardiners Bay and the Peconic Bays provide greater proportions of large winter flounder than the south-shore bays at all seasons. Catch per effort in this area generally compares favorably with that in the south-shore bays. For these reasons, there is good indication that this area could support a larger fishery for this species during both spring and fall seasons.

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SUMMER ROADSIDE OBSERVATIONS OF MARKED COTTONTAIL RABBITS[1]

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ABSTRACT

An exploratory study was undertaken to evaluate box trapping and color marking cottontail rabbits for subsequent observation during early morning roadside counts; 25 rabbits were captured, ear marked with colored plastic strips, and released along 4 miles of survey route. During a following 10-day period, in which the route was run three times each morning, 59 observations were made of 18 marked animals. The marked animals were readily observable and the method appears feasible for more comprehensive study of cottontail activity. Some tentative findings relating to activity patterns are presented.

Roadside censuses during summer are widely used for measuring gross changes in cottontail rabbit population levels. In several states, year to year changes in summer counts are used to derive pre-hunting-season indices of abundance. Considerable research has been devoted to developing this technique. However, little attention has been given to differences in roadside activity between individual rabbits or various age and sex components of a population. This exploratory study was undertaken to evaluate box trapping and color marking as a means of obtaining such information, especially the extent to which marked animals would be observed in subsequent roadside counts.

METHODS

The study was conducted in 1963 along 4 miles of a route comprising two secondary roads in eastern Albany County. These roads are part of a roughly circular 7-mile route that has been surveyed for several years. Box trapping was carried out for 10 days (July 5-14) immediately prior to the census period. A total of 33 box traps, baited with apple slices, were set on road shoulders and lawns adjacent to the route. Traps were placed at selected locations where rabbits had been most frequently observed.

Captured rabbits were measured, weighed, sexed, color marked, and released at the site of capture. They were ear marked with two types of plastic-coated nylon fabric. A brightly colored material ("Saflags", Safety Flag Co. of America) was used for sex identification. Females were marked with red on the right ear and males with yellow on the left ear. A dull-colored fabric ("Fiberthin", U.S. Rubber Co.) was affixed to the other ear to identify individuals. The latter was used in

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five colors providing a total of 10 color combinations, five for males and five for females. Each marker consisted of a strip of fabric approximately 1 x 2 inches, lapped lengthwise over the top of the ear. Both ends of the marker were affixed to the ear with a numbered rabbit ear tag (No. 4-41, National Band and Tag Co.). Also, the tails and rumps of females were dyed red (rhodamine B) and those of males yellow (picric acid). In previous tests, the placement of plastic markers on the tips of the ears greatly facilitated field identification.

To avoid duplicate marking of closely situated individuals, the 33 trap sites were divided into 11 groups, largely on the basis of space and cover relationships. The average distance between traps in the same group was about 100 yards, and that between adjacent groups was approximately 400 yards. Assuming no interchange of rabbits between trap groups, 110 individuals (10 for each of the 11 groups) could be identified on the basis of ear markers and location. Size was also important in identifying individuals.

Early-morning roadside counts, from an automobile travelling 15 to 20 m.p.h., were made by one observer for 10 consecutive days beginning on July 15. Because of its relatively short length, the route was covered three times each morning within the optimal period for observation (5:30-7:30 a.m. D.S.T.). First runs were not made on July 19 and 24. Starting times averaged 5:41 a.m., 6:20 a.m., and 7:02 a.m. All rabbits seen, regardless of their proximity to the road, were recorded. Whenever possible they were classified by size as one-fourth grown, half grown, three-fourths grown or adult. A special effort was made to fully identify marked animals, using fieldglasses when necessary. Locations were noted in terms of nearest trap site.

RESULTS

The most substantive findings related to the effectiveness of the trapping and marking technique used. However, some of the more interesting data on activity patterns are also presented, although it is recognized that the scope of the study was limited and many of the correlations are tentative.

Box Trapping

A total of 296 functional trap nights resulted in the capture of 25 rabbits. Trapping success averaged 0.084 rabbits per trap night or 11.8 trap nights per rabbit. No animals were recaptured. The age and sex of the rabbits marked are given in Table 1. The ratio of males to females was roughly even in both age groups, and the number of adults and juveniles were nearly equal.

Color Marking

The color-marking method used proved very satisfactory. The

TABLE 1. NUMBERS OF RABBITS MARKED AND NUMBERS SUBSEQUENTLY SEEN DURING ROADSIDE CENSUSES

Age when marked*	Male		Female		Total	
	Marked	Seen§	Marked	Seen§	Marked	Seen§
Juvenile						
One-fourth grown	1	1	3	2	4	3
Half grown	3	2	2	1	5	3
Three-fourths grown	3	3	1	1	4	4
Sub-total	7	6(24)	6	4(11)	13	10(35)
Adult	5	2(5)	7	6(19)	12	8(24)
Total	12	8(29)	13	10(30)	25	18(59)

* Average weights (in grams) for the age groups recognized were as follows: one-fourth grown, 485; half grown, 602; three-fourths grown, 795; adult, 1,383.
§ Figures in parentheses represent aggregate number of observations in each case.

brightly colored "Saflags" markers attached to the ears for sex identification were readily visible. On occasion these markers were seen before the rabbit itself was fully discernable. This probably resulted in some difference between the observability of marked and unmarked rabbits. A suggested improvement is the use of a similarly visible material for individual markers; some difficulty was encountered in determining the dull colors of "Fiberthin" markers. (According to a company representative, "Fiberthin" is also available in a brightly colored form.) In terms of durability and resistance to tearing, both materials appeared well suited for animal-marking experiments. The use of two observers in a car would probably result in more complete counts. Dying the tails and rumps of the rabbits did not aid in making identifications.

OBSERVATION OF MARKED RABBITS

During the 28 coverages of the survey route, 59 observations were made of 18 marked individuals (Table 1). This total does not include five sightings in which marked rabbits were not identified with reasonable certainty. Thus, 72 per cent of all marked rabbits were identified during the counts. A slightly higher proportion of juveniles was observed than of adults. The rate was highest for three-fourths-grown rabbits. Six of seven marked adult females were identified as compared with two of five males, but for the sample as a whole little difference was shown on the basis of sex. There were minor differences among various segments of the population in the frequency of observations per marked animal seen.

The proportion of marked individuals identified on any run ranged

Table 2. Relative Numbers of Different Marked Rabbits Observed Each Day During Roadside Censuses

Date (July)	Number identified on each run*				Total
	Run 1	Run 2	Run 3	Average	
15.....	6 (24.0)	2 (8.0)	1 (4.0)	3.0 (12.0)	7 (28.0)
16.....	3 (12.0)	3 (12.0)	1 (4.0)	2.3 (9.3)	6 (24.0)
17.....	4 (16.0)	5 (20.0)	2 (8.0)	3.7 (14.7)	8 (32.0)
18.....	0 (0.0)	3 (12.0)	1 (4.0)	1.3 (5.3)	3 (12.0)
19§.....	.....	2 (8.0)	1 (4.0)	1.5 (6.0)	2 (8.0)
20.....	1 (4.0)	3 (12.0)	0 (0.0)	1.3 (5.3)	4 (16.0)
21.....	1 (4.0)	3 (12.0)	1 (4.0)	1.7 (6.7)	4 (16.0)
22.....	0 (0.0)	4 (16.0)	4 (16.0)	2.7 (10.7)	7 (28.0)
23.....	2 (8.0)	1 (4.0)	1 (4.0)	1.3 (5.3)	4 (16.0)
24§.....	.....	3 (12.0)	1 (4.0)	2.0 (8.0)	4 (16.0)
Average....	2.1 (8.5)	2.9 (11.6)	1.3 (5.2)	2.1 (8.4)	4.9 (19.6)

* Figures in parentheses represent percentage of the total number originally marked.
§ First runs not made on these dates.

from 24 per cent on the first run on July 15 to zero on three occasions and averaged 8.4 per cent (Table 2). The proportion was highest for second runs and lowest for third runs. An average of 20 per cent of the animals originally marked was encountered each day. The same number of different individuals (15) were identified during the last five days of the survey as during the first.

Survey of the route three times each morning afforded a means for measuring the observability of various segments of the population by comparing the various runs on which the same individual was observed. An animal seen on both first and third runs, for instance, presumably had a longer span of observable activity than one seen consistently during only one run or two successive runs. Considerable individual variation was evidenced. In terms of group characteristics the most pronounced difference was that between adults and juveniles. Of rabbits seen at least twice, three of seven adults, compared with only one of six juveniles, were sighted during both first and third runs. Based on individuals seen three or more times, three of five adults were sighted during both first and third runs as compared again with only one of six juveniles.

In 46 observations (78 per cent of the total), rabbits were seen closest to the trap site at which they were originally captured and released; many were observed at almost the exact site of capture. In 10 other instances (17 per cent), they were closest to an immediately adjacent trap site. On three occasions (5 per cent) a nearly full-grown male was seen at least 100 yards from where it was trapped.

Comparison of Marked and Unmarked Rabbits

During the survey there were 218 observations of rabbits, 64 (29.4 per cent) of marked animals and 154 (70.6 per cent) of unmarked animals (Table 3). Included were five marked individuals not posi-

Table 3. Relative Numbers of Marked and Unmarked Rabbits Observed During Roadside Censuses*

Run	Marked	Unmarked	Total
		Juvenile	
1	8 (21.1)	30 (78.9)	38 (100.0)
2	23 (32.9)	47 (67.1)	70 (100.0)
3	4 (13.3)	26 (86.7)	30 (100.0)
Total	35 (25.4)	103 (74.6)	138 (100.0)
		Adult	
1	9 (42.9)	12 (57.1)	21 (100.0)
2	6 (23.1)	20 (76.9)	26 (100.0)
3	9 (50.0)	9 (50.0)	18 (100.0)
Total	24 (36.9)	41 (63.1)	65 (100.0)
		Total§	
1	19 (28.8)	47 (71.2)	66 (100.0)
2	30 (30.9)	67 (69.1)	97 (100.0)
3	15 (27.3)	40 (72.7)	55 (100.0)
Total	64 (29.4)	154 (70.6)	218 (100.0)

* Figures in parentheses represent percentage of total for group.
§ Includes marked rabbits not fully identified and unmarked rabbits of unknown age.

tively identified and 10 unmarked animals that could not be differentiated as juvenile or adult. Of all the adults seen about 37 per cent were marked, while among the juveniles about 25 per cent were marked. The highest proportions of marked adults were seen during first and third runs; for juveniles the reverse was true.

Another difference between adults and juveniles was in the proportions of marked and unmarked animals in the total observations during the first and second halves of the survey period (Table 4). These fluctuated considerably from day to day for both age groups. Yet, for the adults the percentage of marked animals seen was higher for the last half as a whole than for the first half, while for juveniles it was con-

Table 4. Relative Numbers of Marked and Unmarked Rabbits Observed During First and Second Halves of Survey Period*

Group	First half (July 15–19)				Second half (July 20–24)			
	Run 1§	Run 2	Run 3	Average	Run 1§	Run 2	Run 3	Average
Juvenile								
Marked	1.5 (27.3)	2.8 (43.8)	0.6 (33.3)	1.6 (35.6)	0.5 (12.5)	1.8 (25.0)	0.2 (4.8)	0.9 (17.0)
Unmarked	4.0 (72.7)	3.6 (56.2)	1.2 (66.7)	2.9 (64.4)	3.5 (87.5)	5.4 (75.0)	4.0 (95.2)	4.4 (95.2)
Total	5.5 (100.0)	6.4 (100.0)	1.8 (100.0)	4.5 (100.0)	4.0 (100.0)	7.2 (100.0)	4.2 (100.0)	5.2 (100.0)
Adult								
Marked	1.8 (43.9)	0.2 (7.7)	0.6 (50.0)	0.8 (32.0)	0.5 (38.5)	1.0 (38.5)	1.2 (50.0)	0.9 (42.9)
Unmarked	2.3 (56.1)	2.4 (92.3)	0.6 (50.0)	1.7 (68.0)	0.8 (61.5)	1.6 (61.5)	1.2 (50.0)	1.2 (57.1)
Total	4.0 (100.0)	2.6 (100.0)	1.2 (100.0)	2.5 (100.0)	1.3 (100.0)	2.6 (100.0)	2.4 (100.0)	2.1 (100.0)
Total†								
Marked	3.8 (35.8)	3.2 (34.0)	1.2 (37.5)	2.6 (34.7)	1.0 (16.7)	2.8 (28.0)	1.8 (23.1)	1.9 (23.8)
Unmarked	6.8 (64.2)	6.2 (66.0)	2.0 (62.5)	4.9 (65.3)	5 0 (83.3)	7.2 (72.0)	6.0 (76.9)	6.1 (76.3)
Total	10.5 (100.0)	9.4 (100.0)	3.2 (100.0)	7.5 (100.0)	6.0 (100.0)	10.0 (100.0)	7.8 (100.0)	8.1 (100.0)

* Figures in parentheses represent percentage of total in each case.
§ First runs not made on July 19 and 24.
† Includes marked rabbits not fully identified and unmarked rabbits of unknown age.

siderably lower. This suggested a relative stability in the adult population and a change in the composition of the juvenile segment.

To examine this relationship further, the relatively numbers of marked and unmarked animals observed were tested statistically. Records were omitted for the two dates on which first runs were not made. There was no significant difference between the first and second halves of the survey in the observations of either marked or unmarked adults or of marked juveniles. For unmarked juveniles, however, the number of observations during the second half was significantly greater. Apparently, the lower proportion of marked juveniles seen during the second half was attributable to an increase in the number of unmarked animals seen, possibly reflecting an influx of juveniles into the population at that time.

It was also noted that the average number of observations of unmarked juveniles seen on third runs increased from 1.2 per day during the first five days of survey to 4.0 per day during the last five days. The difference was highly significant. Available evidence suggests that this may have been due to a later activity period for "new rabbits" whose appearance has been suggested. Assuming that the span of roadside activity among juveniles, as was indicated by the data for marked animals, was largely limited to periods occurring within two successive runs, an over-all shift in observations toward a later run should have been accompanied by a compensatory decrease in an earlier run. The data showed no such decrease. Furthermore, an over-all shift in juvenile activity should have taken place among the marked as well as the unmarked animals, but this was not the case.

Population Estimates

The observation of marked and unmarked animals afforded the possibility of deriving population estimates by the Lincoln Index method (Lincoln, 1930). Obtaining data by observation, instead of by trapping, would be an advantage because the effect of original capture is considered a biasing influence when trapping is subsequently employed to sample a population. It soon became apparent, however, that several basic assumptions necessary for the valid application of the index were not fulfilled in this study. The composition of the marked sample was not representative of the roadside population as a whole, the proportion of marked animals observed differed between various segments of the population, and an influx of juveniles apparently took place during the study period. It is also known that a high proportion of a population must be marked in order to obtain reliable estimates; Huber (1959) gave 60 per cent as a minimum requirement. In this study only about 30 per cent of all rabbits seen were marked. Thus, daily estimates var-

ied considerably. Those for the entire survey period, based on the three runs separately, showed some similarity, ranging from 81 to 92 animals.

DISCUSSION

Box trapping and color marking constitute a feasible means of studying many aspects of cottontail behavior. The rate of original capture (0.084 per trap night) compares favorably with previous fall, winter and spring trapping success in New York. The absence of recaptured rabbits probably indicates that traps are less inviting in summer than in other periods of the year. That over 70 per cent of the animals originally marked were subsequently identified indicates that a high proportion of rabbits trapped in the proximity of a road will be encountered during subsequent roadside surveys. As many marked individuals were seen during the last five days of survey as during the first. An average of less than 10 per cent of the rabbits originally marked were seen during any one run. The highest proportion was seen during second runs. In previous years on this same route, the highest counts were invariably recorded on second runs.

Of the data pertaining to activity, those relating to range are among the most conclusive. Marked rabbits were almost always seen closest to the trap sites where they were captured. Based on the average distance between traps, the range of these animals would have been about 100 yards in diameter. Actual range was probably much less since individuals were often observed at almost the exact site of capture.

The other findings relating to behavior patterns are tentative at best. Statistics were used as an aid in interpretation and not as means of lending definitiveness to the findings. Certainly, most of the data are too limited to permit conclusions, regardless of how they are interpreted. They do, however, afford information on this method of study.

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EFFECT OF 48 DERIVATIVES OF D-LYSERGIC ACID ON THE SURFACING BEHAVIOR OF LABORATORY FISH[1]

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ABSTRACT

Of 48 derivatives of d-lysergic acid, or ergot derivatives, that were tested on golden shiners and other species of fish, 36 were found to cause surfacing at the concentrations tested. Other symptoms were also noted. It was found that certain species of fish surfaced involuntarily or floated when not moving while in solutions of these drugs. Other species surfaced by positive upward swimming and still others were not affected. Comparative tests on goldfish showed that the compounds varied in effectiveness in relation to concentration. Changes in pH and temperature did not affect the action of the chemicals. It was shown that fish develop an immunity to these compounds. Ultraviolet light caused a rapid breakdown of these chemicals, most of which are fluorescent.

The compounds reported on in this paper are all derivatives of d-lysergic acid, a naturally occurring product derived from an ergot fungus that grows on rye; they will be referred to as ergot derivatives. At present all of them are very expensive and several have been shown to be toxic to humans. For convenience, they will usually be designated by "compound number" as listed in Tables 1 and 2. One of the group, LSD-25 (Compound 13), has been used for decades in research relating to mental disease. It produces hallucinatory and other reactions which are outwardly analogous, in the view of some investigators, to the disease schizophrenia. It has also been used in mental health therapy. The more conventional symptoms include dizziness, sleepiness, nausea, respiratory changes, sweating, etc.

The rate of activity and the actions of mystery snails (*Ambularia caprina*) are affected by LSD-25, LAE-32 and BOL-148 (Abramson and Jarvik, 1955). Mortality sometimes occurs. It has also been demonstrated that the web spinning of spiders is organized by LSD-25 (Witt, 1951). Among vertebrates the social order of the newt (*Triturus v. viridescens*) was changed by LSD-25 (Evans and Abramson, 1958). Turtles are affected as illustrated in this paper. Tests on mammals, including man, have been extensive. An elephant was killed by an injected dose of 0.1 mg/kg of LDS-25 (West, Pierce and Thomas, 1962). The tests on spiders and newts show that LSD-25 is capable of produc-

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ing behavioral changes, an indication that the physiology of the brain may be altered.

Other indolic, hallucinogenic drugs are psilocybin (4-hydroxy-N-dimethyltryptamine orthophosphate) and psilocin (4-hydroxydimethyltryptamine) which are isolated from mushrooms of the *Psilocybe mexicana* group, and bufotenine (5-hydroxy-N-dimethyltryptamine) which is derived from the skin of certain toads and from cohaba snuff. The principal nonindolic hallucinogens are mescaline (3,4,5,-trimethoxy phenethylamine) from the peyote cactus and hashish or marihuana from *Cannabis satina.*

Early investigations showed that several indolic compounds cause surfacing of fish. Among the ergot derivatives, LSD-25 was shown by Abramson and Evans (1954) to cause surfacing in the Siamese fighting fish (*Betta splendens*). The surfacing effects of LAE-32 and BOL-148 were also described (Evans *et al.,* 1956; Baron *et al.,* 1958). Injection of psilocybin produced surfacing reactions similar to those produced by LSD-25 (Abramson *et al.,* 1960, 1963). Abramson *et al.* (1961) and Loeb (1962) described the surfacing effects of LSD-25 on carp and goldfish.

A number of chemicals will cause fish to surface in various ways. Common poisons used in fisheries work often cause a portion of the population to come to the surface. In fact, practically any chemical that causes extreme distress will probably cause some random surfacing. The ergot derivatives (and psilocybin) cause positive surfacing, however. This type of surfacing in *Fundulus* was also claimed for chlorpromazine (10(3-dimethylaminopropyl)-2-chloro-phenothiazine) by McFarland (1959), although it was lethal at all concentrations tested. At present the ergot derivatives are the only known compounds (other than psilocybin) which cause fish to move in a positive direction, usually without killing them. In this case the direction is upward to the surface of the water.

Interest in the potential use of chemicals in fish management (as selective and general poisons, as tools in obtaining population counts, as aids in harvesting fish, etc.) led to the present series of observations in which the effects of many ergot derivatives were recorded for 15 species of fish. The various compounds were tested as received over a period of 2 years. The primary objective was to determine the characteristics of as many of the substances as possible in relation to the surfacing of fish. Of secondary concern was observation of other symptoms produced. No field tests were made with any of these compounds due to their high cost, so it is not known whether fish would surface in their normal habitat. The reaction under marine conditions is also unknown.

THE PHENOMENON OF SURFACING

The physiological routes by which ergot derivatives cause surfacing

have not been investigated; this is also true of all other symptoms caused in fish by these compounds. The chemicals have four visible negative or positive effects depending on the species of fish.

1. They do not cause surfacing, as in the case of the darter or sculpin.
2. They cause the fish to surface involuntarily as if the air bladder were affected. Fish such as sunfish and various minnows fall in this category. These fish often swim below the surface if they are alert, but they rise slowly or sometimes rapidly if they stop moving; i.e., they float when not moving.
3. They cause the fish to reach the surface through positive swimming. Bullheads and trout, for example, often swam to the surface of the water during tests, especially at the beginning. Both trout and bullheads sink when not moving and were usually at the bottom of the tank during tests.
4. Species such as perch and suckers appear to combine both floating and sinking. At times certain individuals must swim actively up to get to the surface and continually did this during tests. Or they might remain on the bottom. At other times these same individuals might involuntarily float to the surface. The patterns of floating, sinking and active surfacing are not stereotyped and vary from individual to individual.

Among fish that actively swim to the surface, only a portion reach the surface. Among involuntary surfacers all individual fish surface, at least in laboratory containers.

METHODS

The 48 ergot derivatives tested were available in only small amounts of 25 to 100 milligrams each. Accordingly, most of the tests were carried out in small containers using three to six fish per test. The compounds, all of which were powders, were dissolved in water, if practical, or in small amounts of ethyl alcohol, acetone or dimethylformamide. The water used was clear springwater having a very low mineral content and a pH of 6.3 to 6.5. Almost all of the tests were carried out at temperatures of 70° to 72° F. The solutions were aerated during the tests. The chemicals were handled, with the same precautions accorded all poisonous compounds, without any known deleterious effects.

The standard fish used was the golden shiner (*Notemigonis crysolencas*) because of its availability in small sizes, its ability to withstand handling and its positive reaction to the compounds. Other species were also subjected to tests with a number of the compounds. The test fish were small because of the small size, 8 to 20 liters, of the test containers. Despite that, the tanks contained too much fish flesh per unit of water for precise determination of effects, but this could not be helped due

to the minute amounts of chemicals available. If larger amounts had been available, it would have been preferable to use tanks containing not more than a gram of fish per liter of water.

The initial concentration of each compound tested was arbitrarily set at 1 ppm and additional attempts to find the minimum concentration that would cause effective surfacing were based on the results of this. The fish were acclimated to the test containers for at least 24 hours before the chemicals were introduced. Reactions of the fish, as compared with controls, were closely observed for the first few hours and frequently thereafter. The average test was continued for a week or more or until the fish had become immune to the action of the chemical. A number of tests were continued until the control fish began to die due to foulness of the water.

It was realized, after testing many of the compounds, that visual evaluation of preliminary and essentially crude tests would not provide a readily measurable comparison of their surfacing effects. Accordingly 12 were tested on goldfish to provide comparative data. All of these compounds were tested at concentrations of 0.1, 0.2, and 0.5 ppm while one was also tested at 0.05 ppm and three others at 1.0 ppm. All tests were run in 1,000-milliliter graduated cylinders using distilled water as the solvent. In each test, 10, 20 or 30 goldfish 1 inch in length were placed in 1,000-milliliters of water at 70° F. through which air was bubbling. After the fish had settled down the compound was taken from a stock solution and added to the cylinder. The number of goldfish at the surface of the water was noted at the beginning of each test and at 10-minute intervals for 70 minutes.

RESULTS OF TESTS

The first series of tests indicated which compounds would cause surfacing behavior among the fish used. They also afforded an opportunity to make observations concerning the nature of reactions by the fish. The subsequent tests with goldfish provided comparative data with respect to the effect of selected compounds.

Occurrence of Surfacing

Of the 48 ergot derivatives tested, 12 did not cause surfacing at the concentrations used for the fish tested (Table 1). The others did cause surfacing for various species as shown in Table 2. Intensity and speed of surfacing varied considerably depending on compound and concentration. Compound 31, for example, caused strong positive surfacing of golden shiners at a concentration of 0.25 ppm while Compound 35 caused only weak surfacing at 5 ppm. The time that elapsed from the start of a test to the onset of 100 per cent surfacing could vary from several minutes to hours.

Table 1. Ergot Derivatives That Did Not Cause Surfacing at the Concentrations Tested

Compound number	Company code number*	Chemical name	Solvent	Fish tested	Concentrations used (ppm)
1	.....	l-lysergic acid	alcohol	golden shiner	1, 4
2	.....	d-isolysergic acid diethylamide	acetone	golden shiner	1, 6.4
3	.....	d-isolysergic acid	alcohol	golden shiner	1, 3
4	.....	d-l-lysergic acid	dimethylformamide	golden shiner	1, 3
5	.....	l-isolysergic acid	alcohol	golden shiner	1, 2
6	.....	d-lysergic acid	water	goldfish golden shiner	11
7	LA-111	d-lysergic acid amide methanesulphonate	water	goldfish golden shiner	3.9
8	A13438	unknown (total fermentation alkaloids)	alcohol	golden shiner	5
9	25851	§	dimethylformamide	goldfish golden shiner	1, 2, 5
10	39985	§	acetone	goldfish golden shiner perch	1, 11
11	38981	§	dimethylformamide and maleic acid	golden shiner creek chub	1, 3, 4
12	40298	§	water	goldfish golden shiner	1, 47

* Compounds 1 to 7 furnished by Sandoz Pharmaceuticals; Compounds 8 to 12, by Eli Lilly & Co.
§ Undisclosed.

Effect of 12 Compounds on Goldfish

Table 2 shows the concentration of each compound that caused 100 per cent surfacing for certain species over a period of hours or days. In Table 3 the time and frequencies of the surfacing of goldfish in different concentrations of 13 chemicals are compared according to a standardized pattern of observations at 10-minute intervals over a period of 70 minutes. The data for Compounds 40 and 47 are shown graphically in Figure 1. The highest concentration of Compound 40 (1.0 ppm)

Table 2. Ergot Derivatives That Caused Surfacing

Compound number	Company code number *	Chemical name	Solvent	Fish tested	Concentrations tested § (ppm)	Remarks
13	LSD-25	lysergic acid diethylamide	water	carp	(1)	
14	LAE-32	d-lysergic acid ethylamide bimaleinate	water	goldfish golden shiner common shiner chub sucker guppy	1, (4)	
15	MLD-41	d-l-methyl lysergic acid diethylamide	water	goldfish golden shiner sucker	(1), 2	
16	BOL-148	D-l-brom-lysergic acid diethylamide	water	goldfish golden shiner	(1), 2	
17	LSM-775	d-lysergic acid morpholide	water	golden shiner	(½), 1	smaller fish more quickly affected
18	ALD-52	d-l-acetyl-lysergic acid diethylamide	water	golden shiner	(¼), ½, 1	
19	LEP-57	d-lysergic acid ethyl propylamide bimaleinate	water	golden shiner	(¼), ½, 1	
20	LMP 55	d-lysergic acid methyl propylamide tartrate	water	golden shiner	¼, (½), 1	
21	LME 54	d-lysergic acid methyl ethylamide tartrate	water	golden shiner	¼, ½, (1)	
22	LMI 56	d-lysergic acid methyl isopropylamide tartrate	water	golden shiner	1/16, (⅛), ¼, ½, 1	

TABLE 2. (*continued*)

Compound number	Company code number*	Chemical name	Solvent	Fish tested	Concentrations tested§ (ppm)	Remarks
23	LPD 824	d-lysergic acid pyrrolidide	water	golden shiner	(1), 2	
24	OML-632	d-oxymethyl d-lysergic acid diethylamide	water	golden shiner	1, (2)	
25	DAM 57	d-lysergic acid dimethylamide	water	golden shiner	(½), 1	
26	EEP 346	6-methyl-8-piperidinomethyl-^{9,10}-ergolen	dimethyl-formamide	golden shiner	(½), 1	
27	DLO 57	4-dihydro-lysergylamido-d-oxazolidone	alcohol	golden shiner	½, (1)	
28	EEM 344	6, 8-dimethyl-^{9,10}-ergolen	acetone	golden shiner	(½), 1	
29	. . . . .	1-oxymethyl-lysergic acid diethylamide	alcohol	golden shiner	½, (1)	heavy mortality
30	24677	N-ethyl lysergamide maleate	water	goldfish golden shiner common shiner chub dace sunfish perch sucker bullhead trout darter lamprey	1, (4)	

Table 2. (*continued*)

Compound number	Company code number*	Chemical name	Solvent	Fish tested	Concentrations tested§ (ppm)	Remarks
31	22985	N-isopropyl d-lysergic acid amide, acid maleate	water, acetone	golden shiner chub sunfish perch sucker bullhead sculpin	(¼), ½, 1, 2	very strong surfacing action
32	A-13438-B	finished mother liquor from the maleate of total alkaloids	water	golden shiner	1, (5)	
33	A-13438-A	crystallized maleate of the total alkaloids	water	golden shiner	1, (2.8), 5	
34	23705	lysergic acid N-phenylamide	dimethyl-formamide	golden shiner	(⅛), ¼, ½, 1	heavy mortality; paralysis of one fish
35	59625	d-lysergic acid hydrazide	dimethyl-formamide	golden shiner	1, 3, 5	weak surfacing action
36	23706	N-(3-methoxy propyl) d-lysergic acid amide, acid maleate	dimethyl-formamide	golden shiner	½, (1), 2, 3, 4	
37	40298	†	dimethyl-formamide	goldfish golden shiner	1, (47)	
38	05932	ergotrate maleate	water	golden shiner	1, 3, 12, (38)	
39	39972	†	dimethyl-formamide	golden shiner	(½), 1, 2, 3	

TABLE 2. (*concluded*)

Compound number	Company code number*	Chemical name	Solvent	Fish tested	Concentrations tested§ (ppm)	Remarks
40	39973	†	dimethyl-formamide	golden shiner	¼, ½, 1 (3)	
41	23773	N-cyclohexyl-d-lysergic acid amide, acid maleate	acetone	golden shiner	¼, (½), 1, 2	heavy mortality
42	23877	N-(dl-sec-butyl) d-lysergic acid amide, acid maleate	acetone	golden shiner	¼, (½), 1, 2	heavy mortality
43	24712	N-benzyl lysergamide maleate	heated water, dimethyl-formamide	golden shiner perch sucker	(½), 1, 2	
44	23208	methyl d-lysergate	acetone	golden shiner sucker	(¼), ½, 1	immediate short-lived irritability; quick deterioration
45	23879	N-(o-methoxyphenyl) d-lysergic acid amide	acetone	golden shiner	½, (1)	
46	24812	†	dimethyl-formamide	golden shiner	½, (1)	
47	23969	N-cyclopentyl-d-lysergic acid amide, acid maleate	dimethyl-formamide	golden shiner	(½), 1	
48	25784	N-(1-methoxypropyl)-2-d-lysergic acid amide, acid maleate	water	golden shiner	½, (1)	

* Compounds 13 to 29 furnished by Sandoz Pharmaceuticals; Compounds 30 to 48, by Eli Lilly & Co.
§ Figures in parentheses indicate minimum concentrations tested that caused rapid 100 per cent surfacing of fish that float when not moving.
† Undisclosed.

TABLE 3. COMPARATIVE EFFECTS OF 12 ERGOT DERIVATIVES AS SHOWN BY THE PERCENTAGE OF GOLDFISH AT THE SURFACE IN TEST SOLUTIONS AT DIFFERENT CONCENTRATIONS

Concentration (ppm)	Time in minutes							
	0	10	20	30	40	50	60	70
Compound 30								
0.0	0	0	0	0	5	5	5	0
0.1	0	10	30	30	30	30	30	30
0.2	0	15	40	50	55	70	70	65
0.5	5	40	70	80	80	90	85	90
1.0	10	70	80	90	100	100	100	90
Compound 31								
0.0	0	5	0	5	0	0	0	0
0.1	5	10	20	25	30	35	30	40
0.2	10	20	30	55	80	85	90	90
0.5	5	75	90	100	100	100	95	100
Compound 34								
0.0	0	0	0	3	7	0	0	0
0.1	0	0	10	20	20	30	30	30
0.2	3	13	17	27	43	47	47	50
0.5	5	10	45	60	65	80	80	90
1.0	0	30	67	77	87	93	97	93
Compound 39								
0.0	10	5	10	10	10	5	15	10
0.1	10	10	35	45	35	50	50	55
0.2	0	30	50	60	70	70	70	75
0.5	5	40	75	95	100	95	100	100
Compound 40								
0.0	3	10	10	13	23	27	10	10
0.1	10	10	10	30	40	50	30	40
0.2	0	6	16	27	42	47	47	42
0.5	7	20	30	33	47	47	47	50
1.0	0	30	30	55	60	45	40	55
Compound 41								
0.0	5	10	0	10	5	0	0	5
0.1	0	10	30	45	70	60	70	75
0.2	5	10	50	85	85	85	85	95
0.5	0	80	90	85	90	90	95	90

Table 3. (*concluded*)

Concentration (ppm)	Time in minutes							
	0	10	20	30	40	50	60	70
Compound 42								
0.0	0	10	10	20	0	10	10	10
0.1	0	10	50	70	60	90	80	80
0.2	0	60	80	90	100	100	100	100
0.5	0	80	90	80	100	100	100	100
Compound 43								
0.0	0	0	5	5	0	0	5	5
0.1	0	5	25	30	55	70	70	80
0.2	5	20	45	65	90	95	100	90
0.5	0	55	95	100	100	100	95	95
Compound 44								
0.0	5	5	5	5	0	0	0	0
0.1	0	15	35	40	45	30	30	25
0.2	5	45	65	70	70	70	80	90
0.5	0	40	70	75	95	85	90	90
Compound 46								
0.0	0	0	0	0	0	0	0	0
0.1	10	15	40	60	45	65	70	50
0.2	5	35	50	75	80	85	90	80
0.5	0	65	90	90	95	100	100	100
Compound 47								
0.0	0	0	7	7	7	7	10	7
0.05	0	15	35	60	65	80	85	90
0.1	0	27	73	93	90	93	93	97
0.2	0	43	83	90	93	90	93	100
0.5	0	70	90	90	90	100	100	100
Compound 48								
0.0	0	0	0	0	0	0	0	0
0.1	0	0	0	10	20	10	10	10
0.2	3	27	30	33	43	50	40	43
0.5	0	30	60	80	90	95	100	100

caused considerably less surfacing than did the lowest concentration (0.05 ppm) of Compound 47.

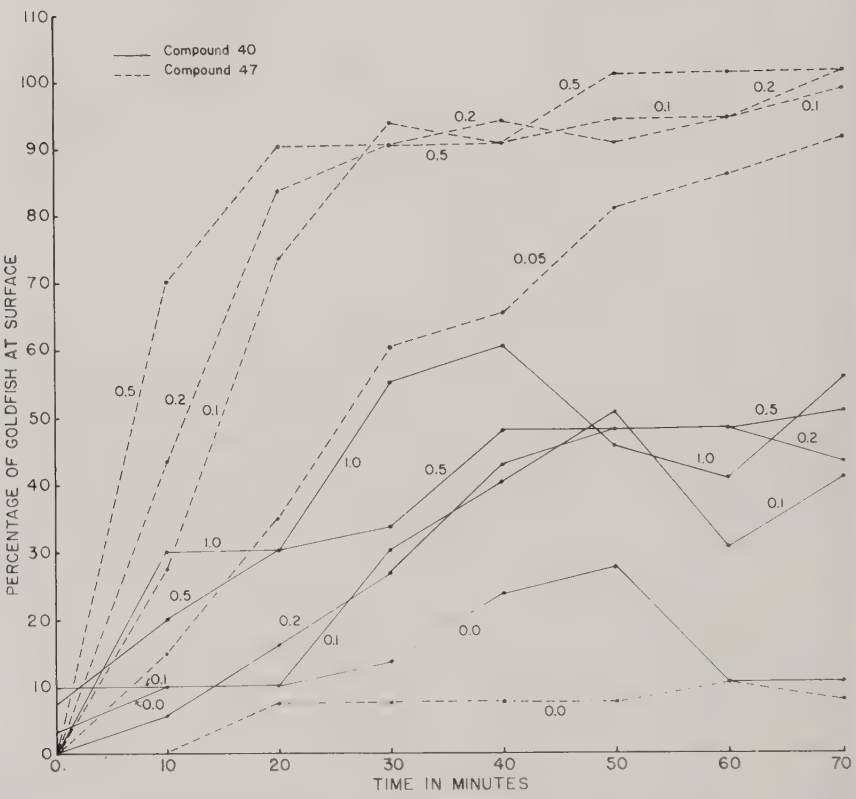

Figure 1. Relative degrees of surfacing of goldfish caused by compounds 40 and 47 at different concentrations. Figures associated with the various lines on the graph represent parts per million.

For each of the 12 compounds the percentage of fish surfacing increased as the concentration increased. Also the percentage of fish that surfaced increased with time at almost every concentration for each compound tested. In only a few tests, at concentrations of 0.1 ppm, did surfacing fail to increase significantly. As would be expected, the higher concentrations caused the fish to surface more rapidly than did lower concentrations. The compounds varied in effectiveness as revealed by the range in percentage of surfacing. One compound caused more surfacing, for example, at a concentration of 0.05 ppm than did any of the others at 0.1 ppm or several at 0.2 ppm. At least one caused less surfacing at 1.0 ppm than did some others at lesser concentrations.

SYMPTOMS, INCLUDING SURFACING, CAUSED BY ERGOT DERIVATIVES

General symptoms noted in fish, other than surfacing, included irritable swimming and darting, backward swimming with the aid of the

pectoral fins, spinning on the short axis of the body (in *Perca flavescens* only), color loss, increase in respiratory rate, fin fluttering, fin extension, fin depression, body warping, trance-like movements and stupor. These varied in individuals and among the different species. Varied concentrations of the 36 effective compounds also caused variations in onset and intensity of symptoms. However, it may be generally stated that most fish exhibited the symptoms either continually or sporadically at almost all concentrations tested. Similar symptoms exhibited by Siamese fighting fish were described by Abramson and Evans (1954). Some variability, even during these limited tests, was noted between compounds; for example, Compound 44 caused much more irritability much more quickly than did other compounds. All of the ergot derivatives show a good potential for the study of sublethal effects on fish. Most observations of fish have involved only visual evaluations of external symptoms. However, Wilber (1962) described a rise in blood pressure for the shark (*Squalus acanthias*) after injection of LSD-25. Following is a summary of the reactions of various species of fish and other animals to ergot derivatives as observed during this study.

Carp (*Cyprinus carpio*): large fish. Compound 13 caused 100 per cent involuntary surfacing in 3 minutes and for many days. Fish floated when not moving, in head-up or horizontal position at surface. Fish slowly developed immunity until normal in 10 days, but recovered when transferred to fresh water after one half to several hours. Color loss was noted.

Goldfish (*Carassius auratus*): small fish. Compounds 14, 15, 16 and 37 caused 100 per cent involuntary surfacing in a few minutes to several hours depending on concentration; fish were alert at lower concentrations, stuporous at higher ones. Fish floated when not moving, in head-up position at surface. Fish developed immunity after several days. Irritability and backward swimming exhibited.

Black-nosed dace (*Rhinichthys atratulus*): small fish. Compound 30 at a concentration of 4 ppm caused 100 per cent involuntary surfacing in 2 minutes and killed fish in a day. Fish floated when not moving.

Northern creek chub (*Semotilus atromaculatus*): small fish. Compounds 14, 30 and 31 caused 100 per cent involuntary surfacing in a few minutes to hours depending on concentration. Fish floated when not moving, in head-up position at surface. Irritability exhibited.

Common shiner (*Notropis cornutus*): small fish. Compounds 14 and 30 caused 100 per cent involuntary surfacing in a few minutes to hours depending on concentration. Fish floated when not moving, in head-up position at surface. Irritability exhibited.

Golden shiner (*Notemigonus crysoleucas*): small fish: All compounds except No. 13 (not tested) caused 100 per cent involuntary surfacing in a few minutes to hours depending on concentration; fish were alert to stuporous depending on concentration. Fish floated when not moving, in head-up position at surface; remained at surface for days. Fish developed immunity, and remained intoxicated for hours to days if removed to fresh water. Mortality occurred at highest concentrations. Irritability and backward swimming exhibited.

Pumpkinseed (*Lepomis gibbosus*): 2- to 5-inch fish. Compounds 30 and 31 caused 100 per cent involuntary surfacing in 2 minutes to a day depending on concentration. Fish floated when not moving, often in head-down position at surface while attempting to swim down. Irritability, backward swimming and pectoral fin fluttering exhibited. Fish released tan pigment in Compound 31.

Guppy (*Lebistes reticulatus*): small fish. Compound 14 caused 100 per cent involuntary surfacing in a few hours and for several days. Fish floated when not moving.

Yellow perch (*Perca flavescens*): 3- to 6-inch fish. Compounds 30, 31 and 43 caused less than 100 per cent surfacing in a few minutes to hours depending on concentration; fish were stuporous at high concentrations. Fish often floated, often sank, when not moving; maintained perpendicular head-up position at surface with pectoral fins. Irritability, backward swimming and warping of body exhibited. Color loss was noted.

White sucker (*Catostomus commersoni*): 2- to 7-inch fish. Compounds 14, 15, 31, 43 and 44 caused less than 100 per cent surfacing in 2 minutes to a day depending on concentration; fish were stuporous at higher concentrations. Fish occasionally floated when not moving, but usually sank when not moving; maintained surface position by swimming. Floating-sinking phenomenon variable in individual fish. Fish often on bottom of tank, exhibited frantic swimming, arched body. Color loss was noted.

Brown bullhead (*Ameiurus nebulosus*): 2- to 5-inch fish. Compounds 30 and 31 caused some surfacing in first few hours, but fish were on bottom thereafter; fish were stuporous at higher concentrations. All surfacing was by swimming; fish sank when not moving. Irritability and regurgitation exhibited.

Brown trout (*Salmo trutta*): 5-inch fish. Compound 30 caused some surfacing as a result of swimming. Fish sank when not moving and were usually at bottom of tank. Irritability and stupor exhibited.

Slimy sculpin (*Cottus cognatus*): ½- to 2-inch fish. Compound 31 caused no surfacing, but fish were stuporous. Color loss was exhibited.

Darter (*Boleosoma nigrum*): 2-inch fish. Compound 30 caused no surfacing.

Lamphrey: 2- to 6-inch larvae. Compound 30 forced larvae out of sand in a day and killed them at concentration of 4 ppm. No surfacing was noted.

Tadpole (*Rana pipiens*): Compound 14 caused no visible effect at concentration of 4 ppm other than slight stupor.

Caddis fly larvae (*Limnophilidae*): Compound 30 killed caddis fly larvae in less than 24 hours at concentration of 4 ppm.

While at the surface (or on the bottom in the case of fish that sink when not moving, i.e., trout and bullheads) fish were either alert or in a stupor. During a typical test the fish began to surface sporadically after minutes or hours. In general, surfaced fish were usually alert to a hand over the tank at low concentrations but in an impervious stupor at higher concentrations. When fish became immune, alertness returned together with less and less evidence of sporadic surfacing. Stupor often preceded death, but most fish lived at effective surfacing concentrations.

The whole surfacing phenomenon involves a period of sporadic movement to the surface with accompanying symptoms, followed by actual continuous surfacing for hours or days in an alert or stuporous condition and then the onset of recovery or immunity, also on a sporadic basis. Any attempt to describe surfacing and other symptoms in more than a general way would be pointless since the tests were not statistical in nature.

EFFECTS OF COMPOUND 31

Supplemental observations with respect to its effect on the respiration rate of fish and on young red-ear turtles were made for Compound 31.

On Respiration Rate of Fish

Compound 31 caused sunfish (*Lepomis gibbosus*) and yellow perch (*Perca flavescens*) to surface, but not the sculpin (*Cottus cognatus*). In all three species, however, the compound caused more rapid movement of the operculae, which was considered to reflect increased respiration. The fish exhibited little body movement during the periods of observation of respiration rate; both perch and sunfish were at the surface, while sculpins rested on the bottom. Respiratory movements of drugged fish were weaker than those of control fish observed in plain water.

Individual sunfish observed at 72° F. had the following rates per minute in various concentrations of Compound 31: 120 in plain water, 120 after 5 hours in 0.5 ppm, 112 after 5 hours in 1 ppm, and 158 after 5 hours in 2 ppm. Perch observed at 72° F. had rates of 78 and 81 in plain water, 120 after 2 hours in 0.25 ppm, and 101 and 168 after 1 hour at 0.5 ppm. Sculpins observed at 47° F. had rates of 50 in plain water, 81 after 18 hours in 1 ppm, 59 after 66 hours in 1 ppm (possibly

illustrating recovery), 88 after 18 hours in 2 ppm, 48 and 88 after 66 hours in 2 ppm, 130 after 46 hours in 3 ppm, and 120 after 46 hours in 4 ppm.

On Young Red-ear Turtles

Four young red-ear turtles (*Pseudemys scripta elegans*), that had been held for several weeks, were placed in 11.5 liters of water held at room temperature and acclimated to the container for several days. All were active and fed readily. Then 1 ppm of Compound 31 was added. Approximately 30 minutes later all of the turtles lost some coordination. Activity remained high but appeared to be aimless and less conscious. Swimming was ineffective with slow to rapid, uncoordinated movements without much forward progress. After 1.5 hours the effects of the chemical appeared to have worn off. All of the turtles exhibited alarm at a hand over the tank but approached a hand at the side of the tank. Both of these reactions had been constant before addition of the chemical.

When examined at 23 hours, all of the turtles were on the float, but one failed to run off. This turtle lay with eyes closed, neck extended and jaw resting on the board. It reacted weakly and showed little coordination in water. On the seventh day this turtle died without regaining any of its former activity. The remaining turtles continued to feed actively, but one of them died 2 weeks after the start of the test. The two survivors were left in the solution for a total of 3 weeks without ill effect. Feeding and growth were normal thereafter.

Compound 31 apparently severely affects this species of turtle. The coordination of the four specimens was initially affected. It appears that the death of the first individual and possibly the second may be attributed to the action of the chemical.

Influences of Temperature and Water Chemistry

Surfacing was unaffected by changes in temperature. Several compounds caused surfacing at temperatures ranging from 58° to 72° F., and one other within a range of 35° to 72° F. During one series of tests of Compounds 18, 21, 22, 26, 27 and 28, all at concentrations of 1 ppm, temperatures inadvertently fell for 24 hours from 70° F. to from 51° to 54° F. No visual changes in the surfacing phenomenon were noted.

In order to further test the effect of extreme fluctuations in temperature, six 2-inch golden shiners were placed in a 5-gallon aquarium containing 4 ppm of Compound 30. Over a period of 13 days the tank temperature fluctuated between 35° and 72° F. several times without visibly affecting the surfacing behavior. The test was started and held at 45° F. for 24 hours, and the temperature was raised to 65° F. and lowered to 38° F. during the second 24-hour period. On the third day it was raised to 65° F. and held there for 4 days. On the seventh and

eighth days it was lowered twice to 35° F. for several hours, after which it was raised to 72° F. and held for 5 days. The shiners began to surface 11 minutes after the start of the test and were definitely surfaced, as compared with control fish, in an hour. They remained at the surface for the following 13 days regardless of fluctuations in temperature. The control fish spent only a small proportion of their time at or near the surface.

Almost all of the ergot derivatives were tested in springwater containing limited amounts of chemicals and having a pH of 6.3. In order to test the effect of higher pH values on surfacing, 50 and 100 ppm of sodium bicarbonate were added to the water, resulting in pH values of 6.7 and 7.2, respectively. A concentration of 4 ppm of Compound 30 in 8 liters of water held at room temperature was used for each test. At pH 6.3, 6.7 and 7.2, results were almost identical. Golden shiners surfaced in 3 to 10 minutes and remained at the surface for 6 to 7 days.

DEVELOPMENT OF IMMUNITY

It has been shown (Abramson *et al.*, 1960) that humans are able to tolerate ingestion of some ergot derivatives in increasing doses over a period of time. This means that a given dose will, when the effects have worn off, produce an immunity to a similar sized or lesser dose, at least for a short period. LSD-25 also produces immunity or cross-tolerance to the effects of MLD-41 and vice versa. Both interact similarly with psilocybin, which is not an ergot derivative but also possesses the indole ring.

Immunity as concerns fish is taken here to mean development of an unresponsive condition in the fish as compared with a previously responsive condition. Immunity was demonstrated a number of times with several ergot derivatives (Table 4). A large sample of fish was not tested, usually 3 to 5 at most, and immunity was discovered as an adjunct to other information being sought about the compound. In a typical test the first group of fish in a solution of an ergot derivative surfaced quickly, but became immune after a number of days. Succeeding groups surfaced for shorter periods as the solution lost toxicity. The variability observed was probably due to small sample size. An example would be Compound 14 in which a first group of fish surfaced in 5 hours while a third group surfaced in an hour. Some differences between the compounds were demonstrated. Compound 44 showed quick deterioration and immunity to it was quickly developed, while the others were of longer duration.

FLUORESCENCE AND THE EFFECT OF ULTRAVIOLET LIGHT ON ERGOT DERIVATIVES

At concentrations of 1 ppm, Compounds 9, 11, 13, 15, 16, 30, 31, 32, 33, 34, 35, 39, 40, 41, 42, 43, 44, 45, 46, 47, and 48 were fluorescent; Compound 8 was not. The bright blue colorations were produced by

Table 4. Development of Immunity to Ergot Derivatives*

Compound number	Concentration (ppm)	Fish tested	Period during which surfacing response occurred				Total days toxic
			1st group	2nd group	3rd group	4th group	
13	1	carp	3 minutes to 10 days	3 minutes to 7 days	3 minutes to 2 days	none	19
14	4	goldfish common shiner golden shiner creek chub	1 hour to 7 days	2 hours to 2 days	.....	.....	9
14	4	goldfish common shiner creek chub	5 hours to 13 days	1 to 3 days	1 to 2 hours	.....	18
			1 hour to 14 days	1 to 4 days	.....	.....	18
15	1	golden shiner	5 minutes to 7 days	1 to 2 days	15 minutes to 1 day	.....	10
15	2	golden shiner	5 minutes to 14 days	2 to 6 days	none	.....	20
30	5	goldfish golden shiner	immediately to 5 days	immediately to 5 days	immediately to <4 days	.....	13
43	1	golden shiner	½ hour to 4 days	3½ hours to 3 days	1 to <4 days	none	10
44	0.5	golden shiner	½ hour to 2 days	1 hour to 1 day	almost none	.....	3

* Data also showed that compounds lost toxicity.

placing an ultraviolet lamp over 8-liter solutions. Differential brightness among the compounds did not appear to be related to their effectiveness in causing surfacing of fish. Compound 31 was visibly fluorescent at a low concentration of 0.1 ppm; in most of the ergot derivatives fluorescence could probably be detected by spectrophotometric techniques at concentrations of less than 1 ppm.

The effect of light on deterioration, or loss of toxicity, was determined for Compound 31 which caused surfacing in golden shiners at concentrations as low as 0.25 ppm. Eight-liter concentrations of 4 ppm maintained toxicity for months in darkness, days under white and fluorescent light, and hours under ultraviolet light. In all cases the solution took on a golden tint as the chemical deteriorated.

A solution containing 4 ppm of Compound 31 was held at room temperature in complete darkness. In 9 months half of the water had evaporated, but the remainder was fluorescent under ultraviolet light and caused small golden shiners to surface in 8 minutes.

A 200-watt incandescent bulb placed 8 inches above a similar solution caused a more rapid breakdown. Fluorescence lasted 10 days and was very slight at the end of that time. The initial time required for golden shiners to surface lengthened as time went on: within 3 minutes after introduction at 72 hours, 10 minutes at 152 hours, 13 minutes after 10 days and not at all after that. Fluorescent light caused a loss of toxicity at approximately the same rate.

A 275-watt ultraviolet lamp suspended a foot over 8 liters of solution caused a quick change in the chemical. The solution noticeably lost fluorescence in 2 hours and became nonfluorescent in 6 hours. Golden shiners which surfaced in 5 minutes at the start of the test, surfaced in 10 minutes at 6 hours and not at all after 9 hours. New fish were used in each case.

A heavy growth of algae took place during the test with incandescent light, and it was thought that it, rather than the light, may have been responsible for the breakdown; but a further test in which algal growth was prevented by adding 1 ppm of copper sulfate produced similar results.

DISCUSSION

The ergot derivatives tested are expensive, toxic substances and for that reason would rarely be suitable for fishery management despite the fact that they cause certain species of fish to surface. Their toxicity, to humans, is variable (Abramson, 1959). Compound 14, for example, appears to be only 1/30 as toxic as Compound 13. But many ergot derivatives remain untested, and it is possible that one of them might be almost nontoxic to humans while causing fish to surface. It is likely that management of sport and commercial fisheries will involve considerable use of chemicals in the future. Any compounds that are capable of moving fish in a positive direction should be of great value. The possibilities are demonstrated by the ergot derivatives.

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EXPERIMENTS WITH A DIBROM-MALATHION FORMULATION AS A SELECTIVE PISCICIDE[1]

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ABSTRACT

Laboratory bioassay tests were conducted on Dibrom-malathion formulations to determine their comparative toxicities to various fish species. The tests revealed that a mixture containing 3 parts of actual Dibrom and 2 parts of actual malathion (by weight) applied at 0.10 ppm was more toxic to bluegills and pumpkinseeds than to largemouth bass; further, that this formulation did not remain lethally toxic, at this dilution, for more than 3 days. Mortality and crippling were delayed by low temperature. Size and weight of the fish affected mortality, the larger fish being more resistant to the chemical.

This piscicide was experimentally tested in five farm ponds and seven lakes. In most instances, upwards of 80 per cent of the bluegills and pumpkinseeds were killed. Almost all the largemouth bass killed were fingerlings (young of the year), particularly those of small size. Mortalities as high as 50 per cent may have occurred in these fingerlings.

The experimental evidence suggests that this formulation could be developed into an effective tool for controlling undesirable populations of bluegills, pumpkinseeds and certain other fishes in many situations.

Adequate fishery management of ponds and lakes usually requires effective control of fish populations and their composition. In a farm pond that contains the familiar largemouth bass-bluegill combination, such control can frequently be gained by manual harvests or by destroying nests of the overly-competitive bluegill. Yet even in these small and relatively simple biosystems, such means are often unfeasible for various reasons and there is need for a practical and suitable, selective chemical. In larger ponds and lakes, the need for selective piscicides is even greater, but the troublesome bluegill and pumpkinseed are still two of the chief targets for control.

The discovery that two organic phosphorus pesticides, malathion and Dibrom[2], were more toxic to the bluegill and pumpkinseed than to the largemouth bass prompted a series of laboratory tests in which the median tolerance limits of a number of freshwater fishes for the two

[1] The authors wish to express their thanks to personnel of the Board of Fisheries and Game of Connecticut and to personnel of the Massachusetts Division of Fisheries and Game for their cooperation and assistance with the field work.

[2] The trade name "Dibrom" has been replaced officially by the common name "naled". It is a phosphate insecticide containing 1,2-dibromo-2,2-dichloroethyl dimethyl phosphate. It is formulated as a liquid containing 8 pounds technical Dibrom per gallon and also as a 4 per cent dust. Malathion, also an organic phosphate insecticide, contains 0,0-dimethyl dithiophosphate of diethyl mercaptosuccinate, and is formulated as a liquid or dust.

chemicals were determined at three water temperatures. The results of these preliminary experiments suggested that if the indicated, higher selectivity of malathion (which required some 2 weeks to hydrolyze below the level of lethal toxicity within a pH range of 6 and 8) could be combined with the more rapid decomposition of Dibrom (which hydrolyzed below lethal toxicity within 3 days) a practical, selective piscicide for bluegill, pumpkinseed and certain other fishes could be formulated. Accordingly, further preliminary experiments were conducted in the laboratory with mixtures of these chemicals, and it was decided that a combination of 3 parts of actual Dibrom and 2 parts of actual malathion by weight of active ingredient offered the most promise. At a concentration of 0.1 ppm of this mixture in a treated body of water, the concentration of malathion would be 0.04 ppm, which is below the observed lethal toxicity of malathion to the fishes tested.

Following is an account of laboratory and field experiments with this formulation. A detailed description of the preliminary experiments has been given by Hoff (1962).

PROCEDURE

Median tolerance values of the 3-2 Dibrom-malathion mixture were calculated by the method suggested by Doudoroff *et al.* (1951). The controlled temperature apparatus was essentially similar to that described by Westman and Compton (1960). It consisted of five 10-gallon aquaria in series, interspersed by four 5-gallon aquaria that served as water-heating containers. These water-heating containers were equipped with 110-volt, 500-watt, tubular heating units of stainless steel that were chiefly on the bottom, and with Fenwall temperature controls. The entire series of aquaria was connected by glass siphon tubes, and the water was recirculated through a Heat-X cooling unit by means of a small centrifugal plastic pump. In short, this was a closed system of water baths with a potential of five different temperatures, and a 5½-gallon treatment aquarium was inserted into each of the 10-gallon water-bath aquaria.

The test fish were held in 50-and 65-gallon stock aquaria, which were equipped with filters and in which the water was recirculated by air lifts, for 1 week before transfer to the treatment aquaria. The fish were acclimated to temperatures in the test aquaria for a period of 48 hours before being submitted to treatment. The sizes and weights of the test fish were measured and recorded after treatment. Four to six fish, from 2 to 4 inches long, were placed in each tank.

Dibrom 8 Emulsive 64.5 per cent active ingredient by weight, and malathion 8 Emulsive 81.0 per cent active ingredient, were the formulations originally employed. Later, California Chemical Company developed a special formulation ML583 which, when used at 1 pint per 4 acre feet of water equalled 0.10 ppm active ingredient, or 0.06

ppm Dibrom and 0.04 ppm malathion. The formulation ML583 was used in all field tests of the 3-2 mixture.

The chemical was first diluted with water, and an aliquot was then introduced into the treatment tanks by means of calibrated syringes. Fifteen species of fish were tested in this manner (see Tables 1, 2 and 3).

In the subsequent field tests, the volumes of the bodies of water to be treated were first calculated somewhat more accurately than is often employed for reclamation by rotenone, and unsual care was taken to achieve proper dispersion of the chemical. The methods of distribution of the chemical varied from gravity feed into the wash of an outboard motor to aerial spraying from a rotenone apparatus. On all occasions, the chemical was first diluted with up to 20 parts of water before application.

Five farm ponds and three "lakes" were treated in New Jersey; two lakes were treated in Connecticut; and two lakes were treated in Massachusetts. Evaluations of fish kills were made not only by direct observation, but also by seining before and after treatment, or by electric shocking before and after treatment, or by seining before treatment and total reclamation by rotenone after treatment, or by combinations of these methods.

RESULTS

The results of the laboratory experiments are summarized in Tables

TABLE 1. RELATIVE TOXICITY OF 3–2 DIBROM-MALATHION MIXTURE TO VARIOUS SPECIES OF FISH*

Species	Number tested	TL_m 48 hours (ppm active ingredient)
Pumpkinseed (*Lepomis gibbosus*)	50	0.075
Bluegill (*Lepomis macrochirus*)	20	0.075
Bluespotted sunfish (*Enneacanthus gloriosus*)	20	0.075
Chain pickerel (*Esox niger*)§	18	0.075
Blackbanded sunfish (*Enneacanthus chaetodon*)	20	0.075
Redear sunfish (*Lepomis microlophus*)	20	0.08
Brown trout (*Salmo trutta*)†	12	0.08
Rainbow trout (*Salmo gairdneri*)†	12	0.08
Redbreast sunfish (*Lepomis auritus*)	12	0.085
Yellow perch (*Perca flavescens*)	12	0.09
Largemouth bass (*Micropterus salmoides*)	50	0.10
Banded killifish (*Fundulus diaphanus*)	20	0.10
White sucker (*Catostomus commersoni*)	12	1.5
Golden shiner (*Notemigonus crysoleucas*)	20	3.2
Creek chubsucker (*Erimyzon oblongus*)‡	12	4.2

* Fish size was 2 to 4 inches and water temperature was 68° to 70° F., except as noted otherwise.
§ Fish size was 12 to 16 inches.
† Water temperature was 55° F.
‡ Fish size was 6 to 7 inches.

Table 2. Relation of Water Temperature to Toxicity of 3–2 Dibrom-malathion Mixture for the Pumpkinseed *

Temperature in degrees F.	Number of fish tested	Time in hours for TL_m
85	8	8.0
75	8	12.5
65	8	20.0
55	8	43.0
45	8	70.0

* Mixture used at concentration of 0.1 ppm active ingredient; fish size was 2 to 4 inches.

Table 3. Relation of Weight of Fish to Toxicity of 3–2 Dibrom-malathion Mixture for the Pumpkinseed *

Average weight in grams	Number of fish tested	Time in hours for TL_m
6	8	10
16	8	18
36	8	37
42	8	48
56	8	71
75	8	§

* Mixture used at concentration of 0.1 ppm active ingredient; fish size was 2 to 4 inches; water temperature was 68° to 70° F.
§ 50 per cent mortality.

1, 2 and 3; those of the field experiments in Tables 4 and 5. While the results of the field experiments were essentially similar to those of the laboratory, it may be noted that the 3-2 mixture was almost always more effective in the field at a concentration of 0.1 ppm than in the laboratory. In other words, this treatment frequently accounted for upwards of 80 per cent of the bluegill and/or pumpkinseed populations when applied to ponds or lakes.

The treatment in ponds and lakes was also considerably more toxic to chain pickerel and yellow perch, and sometimes more toxic to young-of-the-year largemouth bass. Apparently temperature was a significant factor with respect to chain pickerel and yellow perch, and for

TABLE 4. SUMMARY OF TREATMENTS AND RESULTS IN FARM PONDS*

Pond	Date of treatment	Approximate size (cubic feet)	Water temperature	pH	Estimated concentration (ppm)	Species known to be present	Results
1	April 28	26,400	54° F.	6.9	0.10	Largemouth bass Bluegill Pumpkinseed Golden shiner	Estimated kill of sunfishes greater than 80 per cent; no dead bass seen.
2	May 9	282,300	62° F.	7.0	0.10	Bluegill Pumpkinseed Largemouth bass Brown bullhead	Estimated kill of sunfishes greater than 90 per cent; no dead bass seen. Sunfish infested with tetraonchid monogenetic trematodes on gills or strigeid flukes in anterior chamber of eyes died during application.
3	May 9	325,500	65° F.	7.1	0.10	Bluegill Pumpkinseed Largemouth bass Golden shiner Brown bullhead	Estimated kill of sunfishes greater than 90 per cent; no dead bass seen.§
4	May 15	129,000	69° F.	7.0	0.10	Bluegill Pumpkinseed Chain pickerel Creek chubsucker Largemouth bass	Estimated kill of sunfishes greater than 90 per cent; no other dead fish seen.
5	May 26	168,000	75° F.	7.1	0.20	White crappie Largemouth bass Golden shiner Bluegill Pumpkinseed	Estimated kill of sunfishes greater than 80 per cent; no other dead fish seen.†

* All ponds were located in Monmouth County (N. J.); treatments were made in 1961; evaluations were made by seining.
§ Bass spawned 3 days after treatment.
† Prominent thermocline was possible explanation for bass survival at this concentration.

Table 5. Summary of Treatments and Results in Lakes*

Lake	Date of treatment	Size (acres)	Depth (feet)		Surface water temperature	pH	Estimated concentration (ppm)	Species known to be present	Results
			Maximum	Mean					
Silver Lake (Conn.)	August 2	151	12	6.7	77° F. (74° at 7 feet)	7.4	0.10	Yellow perch Pumpkinseed Bluegill Golden shiner Brown bullhead Chain pickerel Largemouth bass Black crappie	Kill of sunfishes extremely heavy and fish still dying after 7 days; many young-of-the-year largemouth bass and 30 yearlings killed; 20–30 adult yellow perch and many young of the year killed; several black crappie found dead.§ Portions of pond obviously received concentrations higher than 0.10; aerial spraying not satisfactory.
Dooley Lake (Conn.)	August 4	28.1 (only 6 treated)	..	..	75° F. (67° at 14 feet)	..	0.09	Pumpkinseed Yellow perch White perch Largemouth bass Brown bullhead	Kill of pumpkinseed only about 300; a few young-of-the-year largemouth bass killed; white perch apparently not in section treated. No oxygen below 5 feet.
Swedesboro Lake (N. J.)	Sept. 15	25 (25.2 acre ft. treated in littoral zone only)	..	..	77° F. (73° on bottom)	9.8	0.10	Rainbow trout Pumpkinseed Bluegill Largemouth bass	No dead fish seen. Littoral zone treatment probably undesirable.
Greenwich Lake (N. J.)	Nov. 8, 13	20	35	18.7	63° F. (53° 24 hours later)	..	0.10	White perch Bluegill Largemouth bass Yellow perch Black crappie Channel catfish Gizzard shad Carp	First application appeared to kill about 80 per cent of white perch population and about 50 per cent of bluegills; one largemouth bass found dead. Double treatment apparently eliminated white perch and about 65 per cent of largemouth bass.† Yellow perch not greatly affected at water temperature of 53° F. Channel catfish and gizzard shad apparently not affected by concentration used. Strong wind during first treatment piled chemical up on northeast shore.
Little Chauncy Pond (Mass.)‡	August 22	44.5	..	7.3	76° F.	..	0.10	Largemouth bass Black crappie Chain pickerel Bluegill Yellow perch Golden shiner Pumpkinseed	On August 24, electric shocking recovered 88 largemouth bass (2–18 inches), 47 black crappie, 2 chain pickerel and 4 yellow perch; only the bass were not in moribund state. On September 14, electric shocking failed to recover a pumpkinseed or bluegill, but 39 largemouth bass (including young of the year), 8 yellow perch, 2 black crappies, 17 golden shiners and 1 brown bullhead were recovered.

TABLE 5. (*concluded*)

Lake	Date of treatment	Size (acres)	Depth (feet)		Surface water temperature	pH	Estimated concentration (ppm)	Species known to be present	Results
			Maximum	Mean					
Johns Pond (Mass.)‡	August 29	225 4 (acre feet)	. .	6	79° F.	. .	0 10	Chain pickerel Pumpkinseed Banded sunfish Largemouth bass Yellow perch Brown bullhead	On October 2 the pond was reclaimed with rotenone. No pumpkinseeds were found, but banded sunfish were common. Largemouth bass were abundant; on the first day of treatment 160 legal bass (10–18.5 inches) were recovered. Less than 100 yellow perch were found; golden shiners were abundant; brown bullheads constituted 80 per cent by weight of all recovered fish.
Homestead Lake (N. J.) .	Oct. 14	2 5 (6,000,000 gallons)	. .	. .	60° F.	6.9	0.10	Largemouth bass Golden shiner Bluegill	Kill of bluegills very heavy by second day after treatment; one age 0 largemouth bass found dead. Seining before treatment and on October 25 indicated kill of bluegills greater than 70 per cent, but largemouth bass were still common and golden shiners abundant.

* All treatments were made in 1961, except that the work on Homestead Lake was done in 1963.
§ J. Galligan (May 1, 1962) reported that electric shocking showed that sunfishes were at 20 to 30 per cent of their previous population level and that large mouth bass and crappies were scarce.
† Evaluation was made by total treatment with rotenone, with Scuba divers assisting.
‡ Data on results furnished by Frank Grice, senior aquatic biologist of the Massachusetts Department of Conservation.

largemouth bass both temperature and the size of young-of-the-year fish were important. In fact, the smaller-sized individuals of all species tested were more susceptible than the larger ones.

The reactions of the fish to the 3-2 Dibrom-malathion mixture were similar to those reported for several organic phosphorus compounds by Henderson and Pickering (1957). The first noticeable change was a darkening of the skin accompanied by an extreme forward positioning of the pectoral and pelvic fins. This was followed by a period of high excitability with body tremors and loss of equilibrium. After loss of equilibrium, the time for death was dependent upon the water temperature; at temperatures below 55° F. fish were observed lying on their sides, but alive, for periods of more than 48 hours, and at 45° F. the time for death was found to be more than 72 hours. At this point, the Dibrom constituent had apparently hydrolyzed, and the majority of fish usually recovered.

COMMENTS AND CONCLUSIONS

The 3-2 mixture of Dibrom and malathion applied at a rate of 0.1 ppm appears to offer an effective and practical method for controlling bluegill and pumpkinseed populations in many warm-water ponds and lakes without undue damage to largemouth bass populations. White perch populations, together with chain pickerel and possibly several sunfishes other than the bluegill and pumpkinseed, can apparently be also controlled by this rate of application. It would seem obvious that the compound has its greatest value where chain pickerel are either absent or unwanted, where trout are not present, and where yellow perch are not highly desired.

It has been the authors' experience that the most desirable results are obtained during spring before largemouth bass have spawned and when the water temperature is between 60° and 65° F. or during autumn when the water temperature is within this range. They have also found the chemical to be most effective when first diluted with upwards of 10 parts of water and applied by gravity feed into the wash of a propeller. Furthermore, the treated area should be cruised several times with the outboard motor immediately following application.

With reference to the toxicity of the chemicals to warmblooded animals, it should be pointed out that malathion and naled (Dibrom) are among the most commonly used insecticides on fruits and vegetables. The residue tolerance of the former is 8 ppm, or 200 times the amount present in these experimental treatments of ponds and lakes, whereas no residue tolerance is on record for the latter. The precautionary measures for handling each of the products are printed on the labels, and no evidence of potentiation or synergism was noted with regard to fish in these experiments when the two products were combined.

Mixtures of the two products can be made at the time of use or several months prior and stored at room temperature. The last experiment on lakes was conducted with a mixture compounded more than two years prior to use (Table 5). Mention should also be made of the care of equipment. Both Dibrom and malathion are very corrosive to metal, and all equipment should be rinsed thoroughly immediately after use.

It would be interesting to discover the effectiveness of this experimental formulation in a wider variety of situations (e.g., harder waters) and on additional species of fish.

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Although this work was done outside New York State, it concerns fish management problems of interest to this Department. However, it represents experimental research only, and further investigation is called for. Publication of these results in no way constitutes a recommendation by the Department for the use of this compound as a management tool at the present time.—Editor

CONVERSION OF 4-(2,4-DB) HERBICIDE TO 2,4-D BY BLUEGILLS[1]

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ABSTRACT

Using electron affinity gas chromatography, the conversion of 4-(2,4-DB) to 2,4-D by bluegills (*Lepomis gibbosus*) was shown. The conversion occurred only in the presence of the fish and not as a result of other chemical or microbiological activity in the water resulting from the presence of the fish.

Beta oxidation of chlorinated phenoxyalkanoic acid herbicides in plants (Bache, Lisk and Loos, 1964; Fertig *et al.,* 1964; Gutenmann and Lisk, 1963), soil (Gutenmann and Lisk, 1964; Gutenmann *et al.,* 1964), and cattle (Bache *et al.,* 1964; Lisk *et al.,* 1963) has been reported. The use of these compounds for aquatic weed control prompted this study of the ability of fish to produce similar metabolites. The conversion of 4-(2,4-dichlorophenoxybutyric) acid [i.e., 4-(2,4-DB] to 2,4-dichlorophenoxyacetic acid [i.e., 2,4-D] can be easily shown by electron affinity gas chromatography, and 4-(2,4-DB) was therefore used in the work reported.

Bluegills (*Lepomis gibbosus*), about 3 inches long, were used as the test fish. The tests were made in 1-gallon wide-mouth glass jars each containing 2,000 milliliters of tap water. A considerable amount of excreta was produced daily in the jars. The experiment was designed to show the possible role of factors other than the fish *per se*, such as bubbling air and microbiological or chemical reactions initiated by the fish excreta on beta oxidation, if indeed the latter reaction should be observed. Seven test jars were prepared as follows:

1. containing three fish and a fritted glass tube air bubbler
2. containing three fish, an air bubbler, and 75 milligrams of 4-(2,4-DB) as the sodium salt dissolved in the water
3. same as Jar 2 but without fish
4. containing 2,000 milliliters of water in which three bluegills had been kept for 7 days and an air bubbler, but no fish or herbicide
5. same as Jar 4 but containing 75 milligrams of 4-(2,4-DB) sodium salt
6. containing 2,000 milliliters of water in which three bluegills had been kept for 7 days, but no fish, herbcide or air bubbler
7. same as Jar 6 but containing 75 milligrams of 4-(2,4-DB) sodium salt

[1] The authors thank A. W. Eipper and J. A. Reckahn for providing the bluegills and A. M. Phillips, Jr. for his helpful suggestions during initiation of this study.

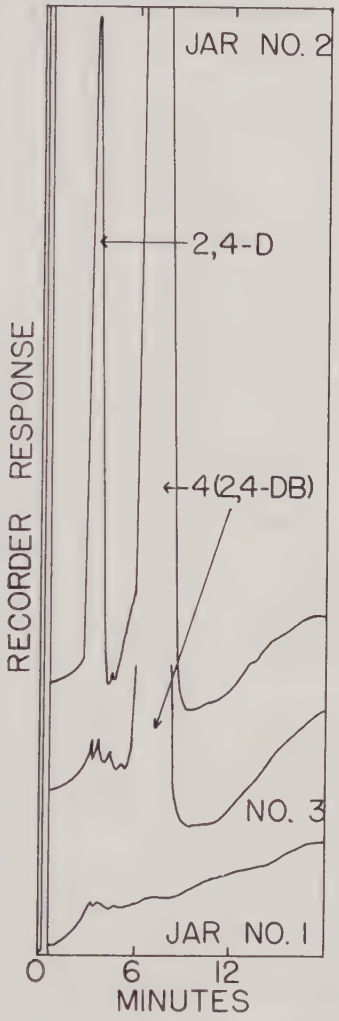

Figure 1. Chromatograms of fourth-day water samples from Jars No. 1, 2, and 3 showing 2,4-D production by fish in Jar No. 2.

The fish were fed "Strike" fish food granules in an acquarium before the experiment began, but no feeding was done during the test period. During the experiment 10 milliliters of water were pipetted from each jar daily and immediately analyzed. The method of analysis consisted of evaporation of 1 milliliter of the water to dryness with air in a 10-milliliter volumetric flask followed by methylation of the residue with 2 milliliters of boron trifluoride-methanol solution. The remainder of the procedure consisting of partitioning the methyl esters into hexane and injection of the sample for gas chromatography was identical to

that reported by Gutenmann and Lisk (1963) except that the column temperature was 225° C.

The chromatograms of samples taken from Jar 2 containing fish in the presence of 4-(2,4-DB) showed a peak identical in retention time to that for methylated 2,4-D. It increased in height progressively from its first appearance on the second day through the fourth day. The experiment was terminated at the end of the fourth day. No peak was present in the chromatograms of water samples from all of the other jars.

Figure 1 shows, respectively from top to bottom, the chromatograms of water samples taken from Jars 2, 3 and 1 on the fourth day. The peaks representing 4-(2,4-DB) and 2,4-D are indicated. Figure 2 shows the increase in 2,4-D concentration in the water in Jar 2 over the 4-day test period. The concentrations of 2,4-D in acid equivalents in the water on the second, third, and fourth days were, respectively, 0.20, 0.50, and 0.76 ppm.

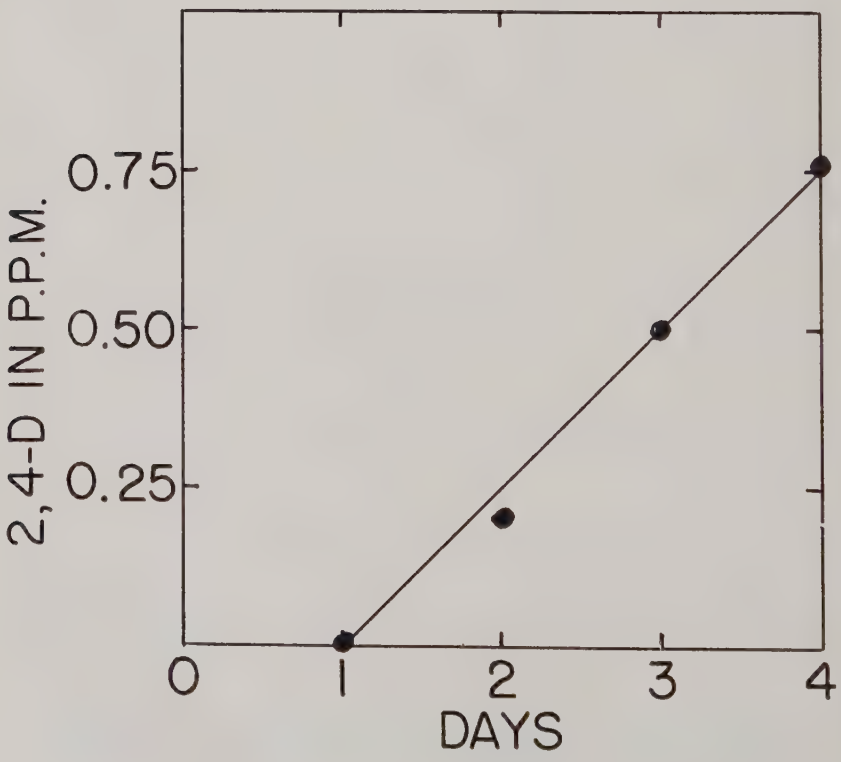

Figure 2. Production of 2,4-D with time by fish in Jar No. 2.

All of the fish remained alive and active during the test. No attempt was made to follow the disappearance of 4-(2,4-DB) quantitatively. Considerable dilution errors have been inherent in its analysis.

The data show the ability of fish to produce and excrete 2,4-D, the beta oxidation product of 4-(2,4-DB), when the latter compound is dissolved in their surrounding water. The excretion of 2,4-D is presumably in the form of a soluble salt analogous to the excretion of water-soluble 2,4-D salts in the urine of cattle fed 4-(2,4-DB) as reported by Lisk *et al.* (1963) These cattle also eliminated about 10 per cent of intact 4-(2,4-DB) salts in their urine. Fish may also excrete a portion of the 4-(2,4-DB) as the intact salt but this could only be determined accurately by capsule feeding followed by water analysis. The lack of 2,4-D production in water containing 4-(2,4-DB) in the presence of fish excreta, bubbling air, etc., but without fish, indicates that these factors are not involved in the conversion.

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GENERAL NOTES

FIRST RECORD OF THE SOUTHERN KINGFISH FROM LONG ISLAND, NEW YORK[1]

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A specimen of the southern kingfish (*Menticirrhus americanus*), 280 millimeters in total length, was taken by haul seine in the ocean surf east of Smith Point Park on Fire Island on May 28, 1964. The water temperature was 48° F. and the salinity was 33.6 0/00 at the time of capture. The fish, a ripe male, was included among a catch of 115 northern kingfish (*M. saxatilis*), and scale examination indicated it was entering its third summer of life. Although Hildebrand

First recorded southern kingfish (*Menticirrhus americanus*) from New York waters.

and Schroeder (1928), Hildebrand and Cable (1934) and Bearden (1963) gave the range of *M. americanus* as New York to Texas, New Jersey has been considered as about its northern limit (Welsh and Breder, 1923; Breder, 1948; La Monte, 1950, 1952). In fact, the northernmost previous records seem to be those listed by Phillips (1914), Fowler (1920) and Welsh and Breder (1923) from southern New Jersey. The present specimen appears to be the first definite record for New York.

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[1] A contribution of Federal Aid in Fish and Wildlife Restoration Project F-15-R.

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OCCURRENCE OF A NORTHERN PIKE IN FISHER'S ISLAND SOUND

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In August 1959 two anglers brought a freshly caught northern pike (*Esox lucius*) to the University of Connecticut Marine Laboratory at Noank (Conn.) for identification. They reported making their catch in Fisher's Island Sound near shore at Groton Long Point, a distance of 17 miles east of the mouth of the Connecticut River. The sportman's catch in this area generally consists of cunner (*Tautogolabrus adspersus*), tautog (*Tautoga onitus*), fluke (*Paralichthys dentatus*), winter flounder (*Pseudopleuronectes americanus*), and striped bass (*Roccus saxatilus*). The condition of the pike appeared good and it was 48.3 centimeters in total length. A light silver body coloration was the only indication of a marine or estuarine origin. Berg (1948) noted that estuarine pike from the delta of the Dnieper River also were light colored. It is suggested that this pike was a stray which came downstream from the Connecticut River to Long Island Sound and followed the less saline inshore waters to Fisher's Island Sound.

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RECENT RECORDS OF PUGHEADED STRIPED BASS FROM NEW YORK[1]

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A pugheaded striped bass (*Roccus saxatilis*) weighing 1,150 grams (2.5 pounds) and measuring 480 millimeters (18.9 inches) in fork length (Figure 1) was caught in mid-May of 1964 by an angler while surfcasting in the ocean at Lido Beach near Point Lookout on the south shore of Long Island. The fish, a 5-year-old female with undeveloped ovaries, had all the features typical of this abnormality. It was well below the average size of normal fish of comparable age and was not well nourished.

Another specimen was taken by a surfcaster at Long Beach on the south shore of Long Island on July 6, 1964 (Keating, 1964). It was reported to have weighed 3 pounds and 7 ounces, and (from a photograph—Figure 2) appeared to be in good condition.

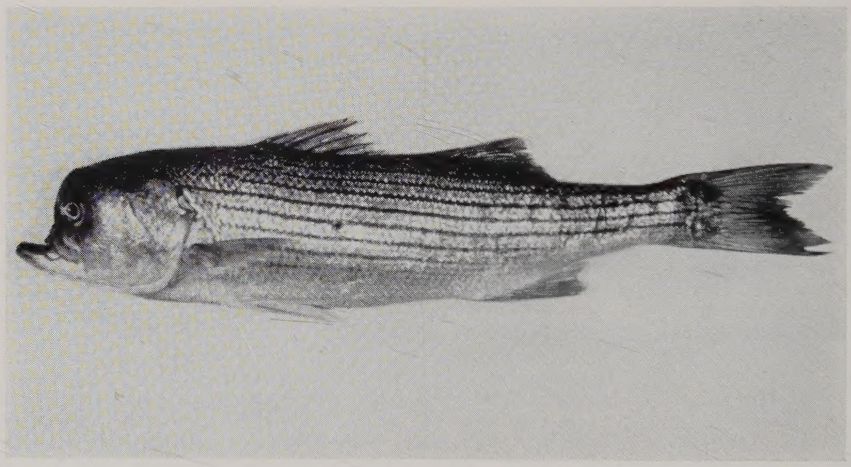

Figure 1. Pugheaded striped bass taken at Lido Beach.

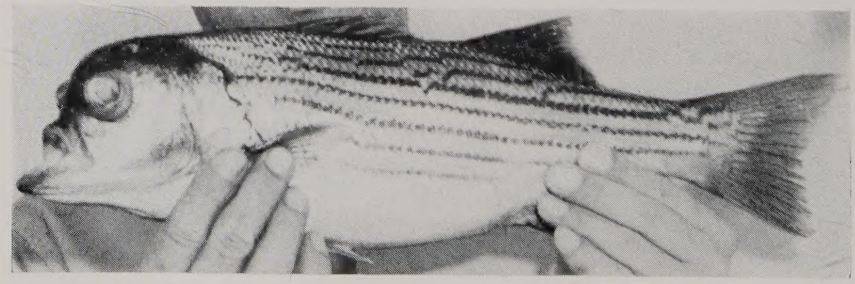

Figure 2. Pugheaded striped bass taken at Long Beach.

[1] A contribution of Federal Aid in Fish and Wildlife Restoration Project F-15-R. The author is indebted to Edward J. Wardle of Point Lookout (L. I.) for contributing the May specimen for examination, to Frank Keating of the Long Island Press and Jack Kertz of Atlantic Beach (L. I.) for data on the July specimen, and to Warren F. Rathjen of the U. S. Bureau of Commercial Fisheries for information regarding the juvenile specimen.

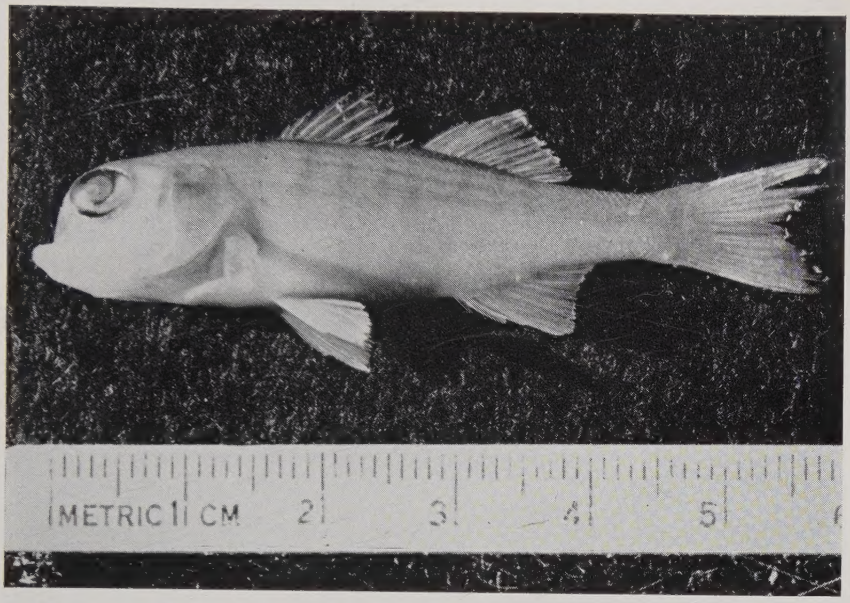

Figure 3. Pugheaded juvenile striped bass taken in lower Hudson River.

A juvenile that exhibited this abnormality (Figure 3) was netted in the mid-1950's in the lower Hudson River during collections of striped bass under Federal Aid Project F-10-R.

Larger pugheaded striped bass (up to 16¼ pounds) have been recorded (Mansueti, 1960; Lyman, 1961). However, specimens previously reported from the vicinity of New York (Gudger, 1930) weighed about the same or less than the adult fish reported here. With respect to juveniles, Mansueti (1958, 1960) cited examples, including postlarvae and young, from laboratory-hatched eggs and field collections.

This deformity occurs in several species of fish. Schäperclaus (1954) compiled evidence to suggest that it may result from a germinal defect in the embryo, although Mansueti (1958) contributed observations indicating that environmental factors may be involved as well. It is probably just coincidence that the two most recent examples from New York were taken approximately 5 miles apart and within a few weeks of one another. On the other hand, it is also likely that this malformation is not rare in striped bass but that most observations are not reported.

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ALGAL EPIBIOSIS AND PARASITISM OF A BLUEBACK HERRING[1]

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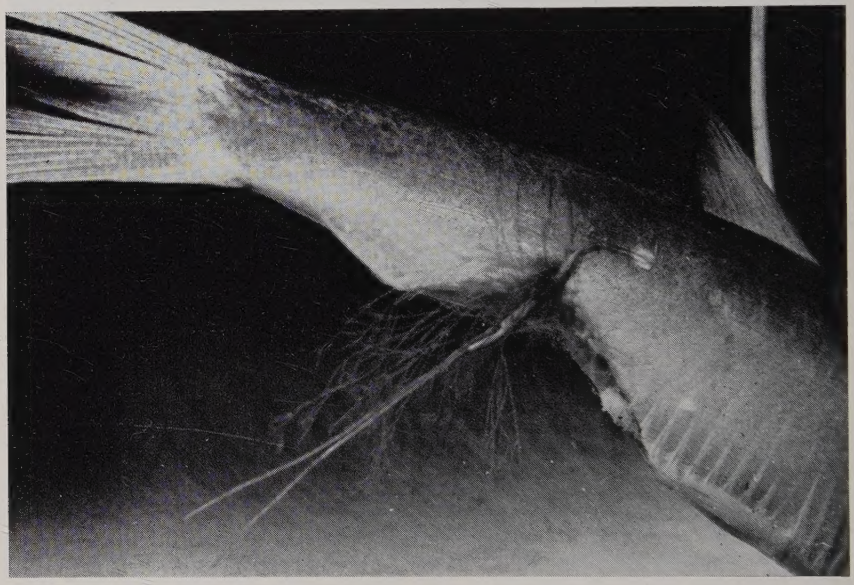
In a collection of shore-zone fishes seined in the surf near Smith Point Park on Fire Island (N. Y.) on October 16, 1964, a blueback herring (*Alosa aestivalis*) was noted that had a tuft of algae attached to a lernaeid copepod which was, in turn, embedded in the right side of the fish's trunk at about the midline and caudad of the dorsal fin. The algae were identified as *Polyisphonia urceolata* (its rich wine-red color had originally attracted attention) together with a few small plants of *Enteromorpha* sp. The basal filaments of the algae were firmly attached



(by basal disks and holdfasts) to the copepod and not merely entangled with it. The copepod was identified as *Lernaeenicus radiatus*. There was no evidence that the herring was handicapped by the presence of these organisms.

Although not noted on other blueback herring captured at the same time, this copepod has been observed on other occasions in Long Island waters on this and similar species, particularly Atlantic menhaden (*Brevoortia tyrannus*). Wilson (1932) reported it on a variety of species in the Woods Hole (Mass.) region. Also, copepods of this species infested with benthic algae have occasionally been observed elsewhere on blueback herring (Wilson, 1917; Sindermann[2]).

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[1] A contribution of Federal Aid in Fish and Wildlife Restoration Project F-15-R. The author is indebted to Edmund Morgan, Park Naturalist at the Tackapausha Preserve of the Nassau County Park Department, who confirmed the identification of the algae and aided in making the photograph.

[2] Dr. Carl J. Sindermann, personal communication.